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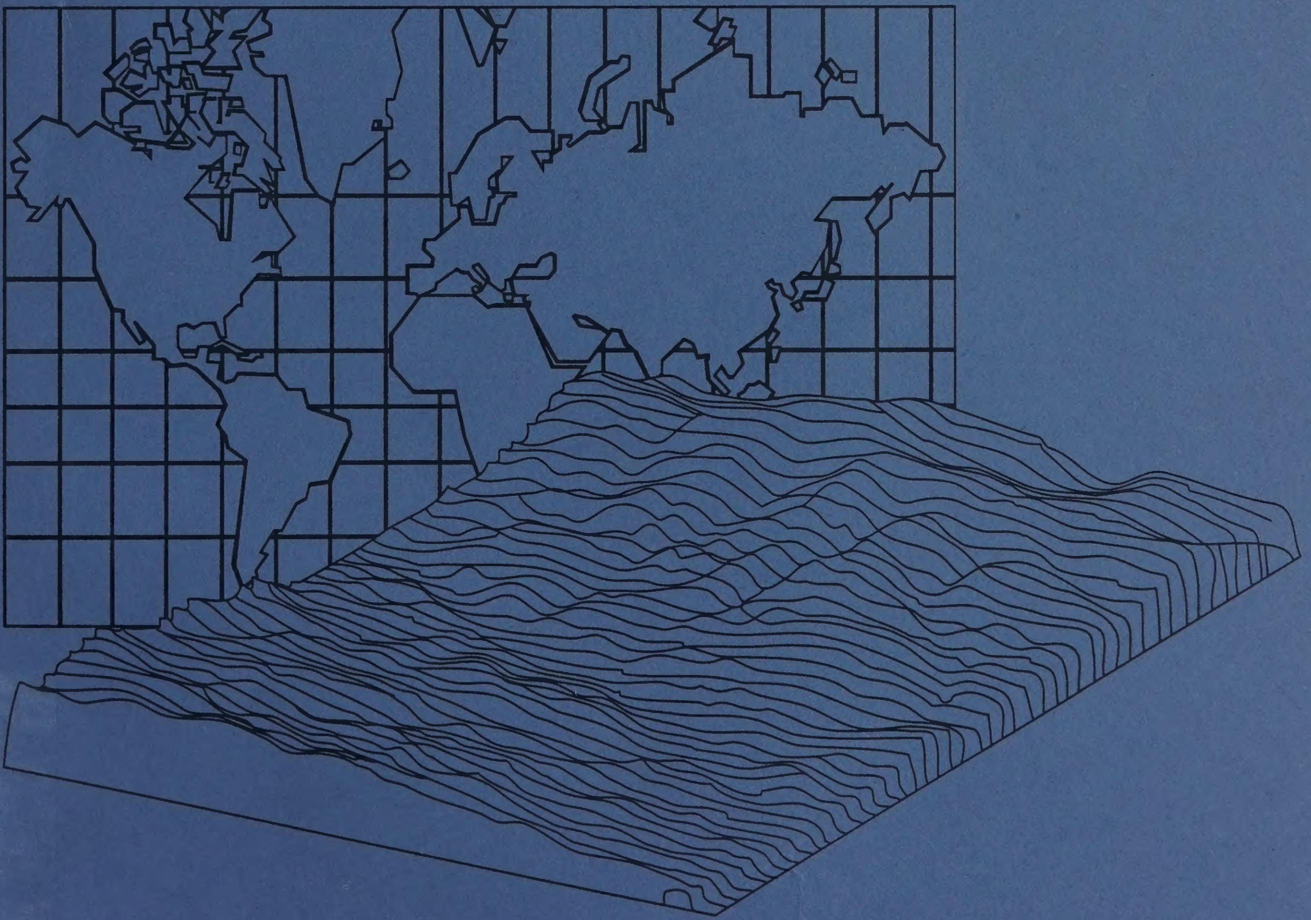
Proceedings from the Eighth Annual MOSS User's Conference

Bozeman, Montana
December 10-12, 1991

Hosted by:
Bureau of Land Management, Montana State Office



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PROCEEDINGS FROM THE
EIGHTH ANNUAL
MOSS USER'S CONFERENCE

December 10-13, 1991
Montana State University
Conference Center
Bozeman, Montana

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On behalf of the Bureau of Land Management, Montana State Office, we want to thank you for your interest in the Eighth Annual MOSS User's Conference.

This year's conference is intended to demonstrate the practical utilization of the MOSS family of geographic information system (GIS) software. The conference is designed to provide information on the current ADS/MOSS/MAPS/COS software status, ongoing ADS applications, GIS database creation/migration, GIS computation modeling, spatial data standards, emerging GIS technology, and current technology issues through a GIS open forum discussion.

To accomplish these goals, the Eighth Annual MOSS User's Conference program consists of technical papers presented over a three day period, a three day poster session, and intra-agency coordination meetings. The technical paper presentations represented in this proceedings volume include both "introductory" approaches for those relatively new to GIS data processing operations, and "advanced" approaches for experienced users.

We would like to thank the attending and participating agencies for their support of the MOSS User's Conference over the past eight years. Second, we would like to thank the members of this year's Planning Committee for their work in organizing and conducting the Eighth Annual MOSS User's Conference. Third, we would like to acknowledge the work of the speakers and poster session exhibitors for their involvement within the conference. Fourth, the staff of the Montana State University Conference Services needs to be acknowledged for their registration and logistical support. Finally, if you are attending the Eighth Annual MOSS User's Conference, we want to thank you for your support. Without the help and participation of these individuals, this conference would not have been possible.

For those attending the Eighth Annual MOSS User's Conference, we hope that the conference leaves you with an enthusiastic interest in using GIS in your business activities. More importantly, we hope that this year's participants will become next year's speakers and poster session exhibitors in advancing the practical application of GIS technology.

Kathie Jewell
Gerald Edler
Loretta Sharp
James Gazewood

General Chairpersons,
Eighth Annual MOSS User's Conference,
Bozeman, Montana

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SESSION 1: GIS SOFTWARE STATUS

TUESDAY, DECEMBER 10, 9:00 AM - 11:15 AM

SESSION CHAIRPERSONS:

Kathie Jewell and Kevin Brooks

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Project sponsor Terry — from Washington &
Project life 18 months
no project manager

BLM GIS ENHANCEMENTS PROJECT UPDATE

Jim Blancett, Chief
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ABSTRACT

A Bureau of Land Management Project Charter has been developed to initiate a software enhancement project for the MOSS GIS software family. This presentation will discuss the six areas of planned software enhancement and the rationale for doing so.

Although the use of the GIS software has been extensive, problems and limitations remain to be addressed in efforts to meet the continuing change and growth of field requirements. The most significant of these require addressing the problems associated with the MOSS polygonal data structure to facilitate the execution of analytical functions such as overlay, buffer, and merge with dissolve.

This issue was presented to the BLM's IRMRC for resolution in January of 1991. The alternatives presented in the issue paper described the options available to BLM in its efforts to support GIS over the next 7 to 8 years until its systems can be replaced through the target system procurement process.
Four alternatives were presented:

(1) Continue minimal support of the current GIS with no major enhancements.
(2) Upgrade the current GIS to a satisfactory threshold.
(3) Replace the vector processing capabilities in MOSS with the New Mexico CDS ORACLE-based prototype.
(4) Replace the entire GIS with a different system or systems.

Alternative #2 was approved by the IRMRC in January of 1991. This action represents a major improvement in the current BLM GIS/MOSS software. The actions for this alternative are in phased approaches, and are the critical items identified at the 1990 MOSS user's conference. They include:

(1) A GIS-Oracle bridge;
(2) Establishment of an interagency version (BLM, USFS, USFWS, BOR) of the MOSS family of software;
(3) Replacement of the overlay, merge/dissolve, and buffer routines with arc-node based algorithms;
(4) Incorporating a utility to generate automated plats, providing for continuing integration of Oracle databases with spacial base data;
(5) Improvement of translators and data sharing capabilities, a more sophisticated file management system; and
(6) A low-level graphic user interface for the MOSS family.

This effort has been given "project" status. The charter is now in final draft form, to be submitted to the Bureau's Information Resource Management Review Council for final approval of the project.

Editor's Note: The presenter may forward proceeding related materials before this talk is given. These materials were unavailable at the time of publication for these proceedings.

ADS SOFTWARE UPDATE

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ABSTRACT

ADS has come a long way over the past five years. Recent improvements enabled easier and more accurate data capturing and improved the user interface. The advantages of the next ADS release include better edgefitting, an ADS/ORACLE bridge, a faster MERGE, access to multiple projects, new features to support GCDB, implementation of maptype 3 and an ADS projection command. Plans for the future include improvements to the database design, more complete processing of DLGs, accurate resolution of duplicate lines, and the completion of the ORACLE features.

Editor's Note: The presenter may forward proceeding related materials before this talk is given. These materials were unavailable at the time of publication for these proceedings.

MOSS Common Source

Mark A. Stephens
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Problem Definition

In the past, three seperate versions of the MOSS family of software were maintained; one each for the Data General and Prime minicomputers and another for Unix workstations. Operating in this mode meant as enhancements or maintenance was made on one system, comparisons of source code for the other supported systems was required. Modifications required the comparison of the source code for all supported systems, rectifying yhe differences and making the changes required to each supported version. Finally, testing the code of all supported versions is required.

To provide a more timely and cost-effective means of maintaining the currency and integrity of all supported versions, a common source development was deemed necessary by the main users of MOSS.

Abstract

Several new routines have been written to take care of specific problems that arose due to the individual hardware platforms. A program was written that distinguishes between the different operating systems that the software runs on so that the correct I/O and graphics routines as well as other hardware specific routines can be called. Algorithms were standardized by removing all unnecessary computations and all variables were explicitly declared in every program. All routines contain explicit declarations. All dimensions in subroutines conform to FORTRAN77 convention to provide greater flexibility. The result is a faster, cleaner, more robust version of code that outperforms the old version. A new version of buffer is also included which in most cases will actually cut buffering time in half.

Unix-Version of MOSS

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Problem Definition

The MOSS family of software was developed and has been operating in the mini-computer environment for several years. GIS functions entailing spatial analysis and resampling are CPU and I/O intensive. Therefore several MOSS functions operating in a mini-comuter environment lack the desired performance in an operational environment.

Hardware technology has exploded in recent years particularly in the area of Reduced-Instruction-Set-Computer (RISC) workstations. RISC workstations provide processing power and memory unheard of just a few years ago. In addition to the increased power and memory, windowing and graphics standards are becoming a reality in the Unix environment.

MOSS was developed utilizing Tektronix graphics utilities which limited the portability of the software to various hardware platforms. The immergence of X11 and Motif windowing and grahics standards provide tools to re-engineer MOSS for portability to any platform that supports those tools.

Abstract

Autometric has developed a Unix version of MOSS that operates on Unix workstations that conform to X11.4/Motif standards. The development entailed a complete re-engineering of MOSS, MAPS, and AMS applications software. All I/O and graphics calls were modified and menus were replaced with push buttons and widgets inherent in X11.4/Motif. The size of the multiple windows can be modified in accordance with X-Windows standards. The Human-Machine-Interface (HMI) has been standardized between MOSS,MAPS and AMS.

The performance gains acheived by executing MOSS on a Unix workstation are significant. Some initial benchmarks indicate performance gains in the area of 18 to 1 on complex buffering functions. The use of the processing power and memory capabilities makes the performance of MOSS more viable in a production environment.

The re-engineering of MOSS software to utilize X11.4/Motif standards has made the software portable to any Unix platform that conforms to those standards.

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SESSION 2: ADS APPLICATIONS

TUESDAY, DECEMBER 10, 1:00 PM - 4:30 PM

SESSION CHAIRPERSONS:

Wendy Tetley and Jodie Hamilton

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FOREST BIODIVERSITY ANALYSIS USING ADS/ORACLE AND MAPS

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ABSTRACT

Occasionally in the operation of a GIS, a need arises for which there is no existing solution. Such was the case when two projects in 1991, Spotted Owl Critical Habitat Unit construction and Forest Operations Inventory "clumping" for biodiversity studies, arose at the Oregon State BLM office. The objective of both projects was to manipulate existing data into a new theme with selected interior polygon boundaries dissolved. The joining of polygons would be based on certain attributes of the polygon, not yet assigned to the data. This presented two problems without solutions:

> 1) The MOSS Merge/Dissolve function was designed to dissolve boundary lines between maps, but has no utility for interior lines. The ADS software offers the ADJACENT function, which does perform interior line dissolve. However, the command required that the user interactively verify the joining of every set of polygons suitable for combining -- a time-consuming process;
>
> 2) Another limitation surfaced with the need to easily select and modify existing attributes in the ADS map, in order to prepare the polygons for joining. The existing source data consisted of polygons with unique attributes. We needed to find an automated method of assigning new attributes to these polygons, based on information previously noted in the map. These new attributes would then be used to create new polygon features by dissolving the lines between adjoining polygons of the same value.

This paper will discuss enhancements made to the ADS software, partially as a response to the needs of WODDB. The development of an ADS/ORACLE bridge and a modification to the ADJACENT command presented a solution to achieve our goals.

One of the final objectives of these projects was to create a map covering the entire WODDB study area from township-based data. The problem of removing duplicate lines created by merging adjacent WODDB townships still goes unsolved. The supplied ADS version with enhancements was not an official release. Working with a BETA version of the software, several unexpected bugs were encountered. The paper will review obstacles that arose -- those which were associated with the test status of ADS and those which present a version-independent dilemma.

Editor's Note: The presenter may forward proceeding related materials before this talk is given. These materials were unavailable at the time of publication for these proceedings.

ATLAS INDEX: USING ORACLE TO QUERY AND TRACK ADS DATA

The GIS ATLAS INDEX was created in ORACLE and linked several existing databases together, along with a listing of current ADS data. The basic purpose of the ATLAS 'Menu-driven' system is to encourage the use of GIS as a tool for resource projects, by making it user friendly while answering some of the most frequently asked questions. So, the user logs in; types the word 'ATLAS'; then selects a number from the screen options. ATLAS can display the current GIS data, which computer the data resides on, description of each data theme (specifying certain standards, when appropriate), and link the 'English' mapname, the computer 'mapname', and the township/range. So, queries can be made by specifying any one of these parameters and hardcopies can be easily printed. The 'Users Manual' gives examples of each option. Additionally, the ATLAS provides several other application platforms, which could be developed in more detail, as needed; e.g. Data, Standards and Project Tracking; Database Management; etc. By experimenting with Plat Graphics Utility (or Common Data Structure), ATLAS INDEX Maps have also been produced.

ATLAS runs in ORACLE on the PRIME minis or on PCs. Updating can also be done, either by running an existing macro periodically, or choosing screen option #5. So, given access to an existing PRIME or PC with ORACLE, there is no other cost. Presentation will include existing query capability, development, maintenance and future development opportunities.

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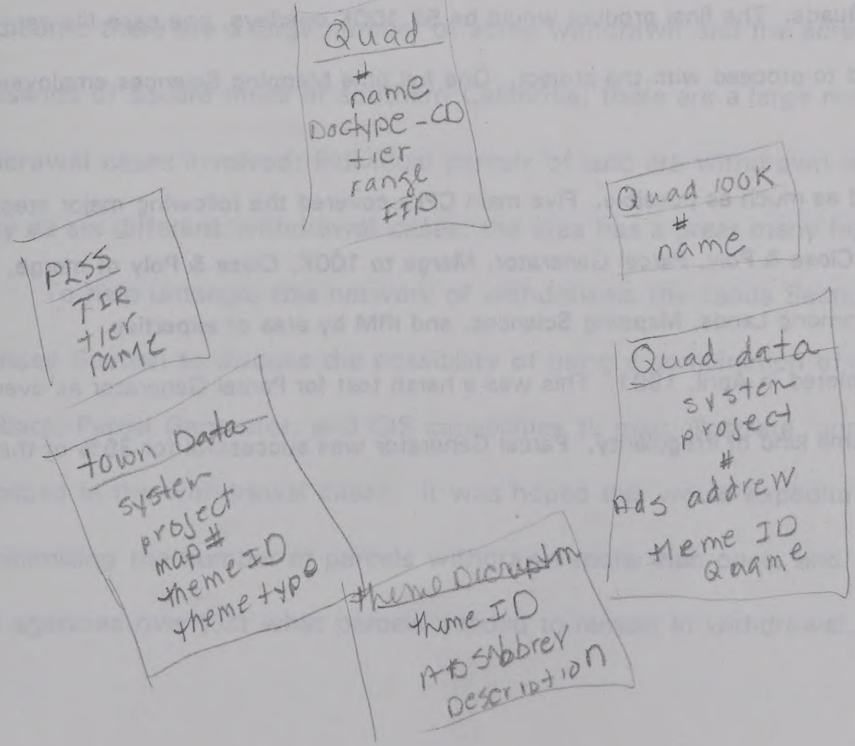
New Mexico State Office; BLM FAX 847-6267

DATA MODEL FOR ADS DATA

In conjunction with developing the GIS Atlas in Oracle, we began to develop a partial data model that was compatible with the Bureau's Data Element Dictionary and with the Baseline model for the GCDB collection. This model was elaborated on when we began to develop a data management plan and is now implemented in Oracle on the Prime. This set of tables allows us to track current ADS data, 100K map updates, ADS theme definitions and ties ADS data to data currently collected by our GCDB and ADP staffs. Presentation would cover the basic data model we are using and how it can be tied to other Bureau data tables. (Should follow directly behind presentation given by Elizabeth Peck as they are heavily interdependent)

Judy Baird FTS 847-7470 (or 476-6332) BLM New Mexico State Office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The Application of Parcel Generator to a Large-Scale Lands Project

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For Oral Presentation

ABSTRACT

In December, 1990 the Lands Section CASO had 34 Bureau of Reclamation withdrawal cases come up for renewal. The cases represented a complex network of overlapping, multi-withdrawn parcels in irregular Townships. The Lands Section proposed to use Parcel Generator to help review the cases and discussed this possibility with Mapping Sciences and IRM.

By 14 December, the general nature and form of the project were agreed upon. Preliminary data inventories and two test areas were completed by 29 January. An estimate of work months was completed by 4 February so that a go or no-go decision could be made at that time.

It was found that the 34-case project involved 133 townships on 373 7.5' quads covering 19 100K Surface Management Quads. The final product would be 53 100K overlays, one case file per 100K overlay. It was decided to proceed with the project. One full time Mapping Sciences employee was allocated to the project.

CPLs were to be used as much as possible. Five main CPLs covered the following major steps: Township Extract, Township Close & Poly, Parcel Generator, Merge to 100K, Close & Poly of merge. Responsibilities were divided among Lands, Mapping Sciences, and IRM by area of expertise.

The project was completed in April, 1991. This was a harsh test for Parcel Generator as over 60% of the townships had some kind of irregularity. Parcel Generator was successful for 35% of the parcels.

Introduction and Background to the Project

The General Situation

The Bureau of Land Management (BLM) in California is organized into four Districts: Susanville and Ukiah in northern California, and Bakersfield and the California Desert (Riverside) in southern California. Each District is subdivided into from three to five Resource Areas for a total of fifteen throughout the State. The BLM administers over 17 million acres of Public Land in the state of California.

One of the functions of the BLM is to administer all withdrawals of public lands. In southern California one of the largest sources of withdrawals are those held by various water districts, county, state, and Federal agencies. Many of these water withdrawals came up for renewal in 1991. These withdrawals are located along the Colorado River, along some of the many canals and aqueducts located in the area near the Arizona - California border and the U.S. (California) - Mexico border, and in the Salton Sea area, California.

The character of these withdrawal cases is such that they are complicated by four conditions: there are a large number of acres withdrawn and the acreage is scattered over thousands of square miles of southern California; there are a large number of individual withdrawal cases involved; individual parcels of land are withdrawn more than once - by as many as six different withdrawal cases; the area has a great many highly irregular Townships.

To help untangle this network of withdrawals the Lands Section met with the Mapping Sciences Section to discuss the possibility of using a combination of the BLM's ORCA Case File data, Parcel Generator, and GIS capabilities to map, illustrate, and manipulate the parcels described in the withdrawal cases. It was hoped this would expedite and simplify the process of minimizing the number of parcels withdrawn more than once, and facilitate negotiations with agencies over just what parcels needed to remain in withdrawal. Information Resources

Management (IRM) was included in the discussions as they would play a technical support role in the areas of software use, data management, and automation of the process.

By 14 December 1990 it was decided to go ahead with a test to check the feasibility of the project. Lands would have the Title and Records section begin entering the ORCA data to reside on the Honeywell DPS6 at the California State Office (CASO). Mapping Sciences would begin working on data inventories and run two test areas when the ORCA data was ready. IRM would examine the Parcel Generator process and begin developing Command Procedure Language code (CPLs) to automate the process where possible, and would handle the loading of the ORCA data from the DPS6 to the CASO PRIME 6650, where the GIS software and data resides.

Mapping Sciences completed the preliminary data inventories and two test areas by 29 January 1991. The project consisted of 34 Withdrawal Cases, covering 133 townships: each requiring an ORCA township data file. The 133 townships covered 373 7.5' quads, 19 100k Surface Management quads and six 250k quads. It was estimated by IRM that two workers could complete the township extract and Parcel Generator portions of the process in one week. It was thought that the GIS edit and plotting portion could be completed by one person in four to six weeks. A total estimate of two work months was agreed on. The decision was made to proceed with the project: one full-time Mapping Sciences employee was allocated to the project with assistance as needed from Lands, IRM, and other Mapping Sciences employees.

Data Types and Sources

Input data types required to run Parcel Generator are of three types: ORCA case files which describe the parcels, the public land grid in township format, and the public land grid as 7.5' quads from which the township format is extracted. Also needed are the map collars to which the resulting township format parcel maps are to be merged (such as 100k) if different than the 7.5' quads from which the public land grid is extracted.

For this project, the Withdrawal Cases did not exist as ORCA files on the DPS6 and were keypunched in-house by Title and Records data entry personnel specifically for this project. This process took approximately two weeks and was completed by the middle of January, 1991. These data files were then transferred from the DPS6 to the PRIME using general magnetic tape utilities. On the PRIME the files exist as ASCII files and reside in the ADS project along with the map files with which they will be used.

In California the public land grid data layer is stored by the theme name PUBLIC.GS. Mapping Sciences inventoried the PUBLIC.GS data in the ADS data base and found that we had 100% of the needed coverage. The PUBLIC.GS data exists as 7.5' quad map files and are from three sources: USGS Digital Line Graphs, contractor-digitized data, and in-house digitized data. It was also determined that each of the 100k map collars needed already existed from previous in-house efforts. Mapping Sciences began to compile lists, indexes and cross references establishing which Cases were on which townships, what townships were on what 7.5' quads and so forth.

Output data would consist of intermediate products and final products. Intermediate products are township PUBLIC.GS map files and township parcel map files of the theme WD.WITHDRAWALS: both at the 7.5' scale. Final products are the completed 100k ADS and MOSS map files of the WD.WITHDRAWALS theme and the planned MOSS plot files illustrating case files at 100k, 250k, and 750k map scales.

Data Organization

On the PRIME 6650 at the CASO, the ADS and MOSS data disks are organized into projects (directories) by 100k map sheet for the entire state. Due to disk space limitations, both ADS and MOSS data must reside on "split" disks: projects starting with A through N on one disk, O through Z on another. A major decision had to be considered as whether to distribute input data files at the beginning of the project or output data files at the end of the project.

Both methods have advantages and disadvantages. After some consideration, it was decided to emphasize making the data available in the appropriate MOSS project as soon as possible, and to have the WD.WITHDRAWALS theme generally available for use during the life of the project. This required distributing the processing to existing ADS projects from the very start of the project. Many townships are present in from two to four 100k project areas and this would require copying township data files to each required ADS project.

IRM - Support

General Duties

IRM's immediate duties in the project were of transferring ORCA data from the DPS6 to the PRIME, minimizing down-time of the PRIME, and acting in a technical GIS support role. There was a need to edit all of the ORCA data files to add an end-of-case record between every section. This was to address a special request from Lands to have map file results which had sections for each Case Number distinct from other sections, but have no parcel boundaries interior to the sections for each Case Number. Mapping Sciences and IRM disagreed with Lands on this modification for two reasons: the added work load of editing the files, and the fact that it would not often be possible to use the GIS to pull individual parcels from the complete parcel map files.

Due to a Parcel Generator bug it was also necessary to break multiple aliquot part descriptions on one ORCA data record into multiple records with one aliquot part description per record. This bug was repaired near the end of the project.

Of major importance was an examination of the entire Parcel Generator process to identify repetitive tasks for automation. Automation as used here means writing PRIME CPLs which loop continuously for entry of input parameters and run ADS macros as either batch jobs or interactively to do the actual work.

The Parcel Generator process was found to have thirteen major steps, six of which could easily be fully or partially automated. Of these six, conversion of ADS data to MOSS data already has an established batch procedure. It was decided to automate the remaining five steps. These are as follows: ADS merge to extract townships from 7.5′ quads of the theme PUBLIC.GS, ADS close and poly of newly created township PUBLIC.GS map files, the running of Parcel Generator, ADS merge to combine township parcel maps (theme WD.WITHDRAWALS) into 100k parcel maps, ADS close and poly of newly created 100k parcel maps.

Organization of CPLs

CPLs were written for each of the five steps identified for automation. The ADS edit CPLs merely did an initial closure and polygon formation run to generate a list of errors to be corrected. In addition to the five main CPLs, four dummy files and five other "sub" CPLs were available for various purposes. User and ADS project directory house keeping functions were incorporated into the CPLs to control the growth of miscellaneous files during the life of the project.

Of special interest is the CPL written to accomplish the extract of townships using ADS merge. A township may exist on from one to as many as four 7.5′ quads. The technique used to accommodate this was to check for NULL values after the entry of each 7.5' quad name through the entry of the third quad. Four dummy ADS merge batch job files resided in the directory of the ADS user. The CPL then used the ED line editor to edit the dummy batch file appropriate to the number of 7.5' quad names entered. In this way it was possible to build a run file using the correct values for the particular run. The file was saved to a batch file whose name was incremented through iteration, and the job spun off to a batch queue. This enabled continuous operation of the CPL: no waiting for an interactive job to finish.

Generally, each CPL started by checking the attach point from which the CPL was started. The CPL would inquire as to which ADS data disk would be used, and then would attach to the appropriate ADS user directory. The CPL main loop would then begin for entry of the information necessary to run the ADS macro. CPLs were ended by a blank carriage return in answer to a DO YOU WANT TO CONTINUE? prompt at the beginning of the main loop. At break out from the main loop, the CPL would call its house-keeping function, re-attach to the directory from which the CPL was started and then end.

Data Management

Data Management from the IRM perspective had many forms, most of which have already been mentioned. The ORCA files had to be loaded onto the PRIME, edited as required, and distributed to each ADS project directory in which it was needed, as did the 7.5' PUBLIC.GS map files.

Whenever a CPL bombed, for whatever reason, it was necessary for IRM to delete all files created by the failed run. It would then be necessary to run the ADS project update function before the CPL could be run successfully on the same data set.

Mapping Sciences - Production

Experience with CPLs: Problems

The two largest problems Mapping Sciences encountered in using the CPLs written by IRM were the time it took to simply run them, and work delays caused by CPL bombs. IRM's estimate of the time it would take to run the township extract and Parcel Generator CPLs was inaccurate. It took longer to run the CPLs than the ADS edit functions which were assumed to be a more time intensive process.

One cause of added time was the need to pause and improve the cross reference lists of townships, Case Numbers, and 7.5' and 100k map sheet names. Running the many township extracts was best done with a simple hand-prepared cross reference list of Townships and 7.5' quads by word name and USGS coded name. There was a high frequency of CPL re-runs required and these also contributed considerably to the amount of time required.

Township attributing by the BLM in California is supposedly standardized to the ALMRS format: 0SS; 0TT0N0RR0E. SS is the section number; TT the township value; N is either N or S for north or south of baseline; RR is the range value; and E is either E or W for range east or west of meridian. At least three different formats exist for township attribute coding in the CASO PRIME ADS and MOSS data bases. It is estimated that 90% to 95% of the attributes are of the correct format. The source of the inconsistencies is probably a combination of simple data blunders and the diversity of PUBLIC.GS data sources.

The manifestation of the attributing problem is incomplete township extract during ADS merge. The merge is done on the basis of a search string which is the coded township attribute. If the attributing is incorrect on one or more 7.5' quads, that data is omitted from the merge. It would then be necessary to correct the attributing in ADS edit, and re-run the township merge.

Data file causes of CPL bombs included incomplete PUBLIC.GS file copying to each 100k project directory and errors introduced into ORCA files during editing. The large time delays involved with CPL re-runs were procedural since coordination with IRM was necessary for file deletion.

Another small but significant factor in the time for CPL runs was the design of the CPLs by IRM. There is little user-friendliness built into the CPLs, no review of entered data prior to being committed to a run, and only the barest minimum of error trapping to minimize operator input errors. The CPLs were designed to be "work horses" and overall they were a useful time-saving element to the project.

Experience with ADS Edit: Problems

For the most part, ADS edit of township PUBLIC.GS map files and 100k WD.WITHDRAWAL parcel map files was the smoothest portion of the Parcel Generator process. This can largely be attributed to the relative simplicity of most of the data: simple rectangles and parallelograms.

Advantages provided by ADS were used where ever found to be useful. For instance, thousands of duplicate lines were eliminated in the extract of townships by taking advantage of the variable tolerance duplicate line removal feature in ADS merge. A tolerance of 0.20 was used: this took care of better than 90% of the quad boundary and adjoining polygon duplicate lines.

Another labor saving feature of ADS merge is the ability to have duplicate attributes deleted. Only exact attribute string matches within a single polygon are deleted. Those which do not match are left to be examined during the ADS edit procedure. This worked well in township extract for eliminating duplicate section/township polygon attributes. This project was somewhat unusual as several attributes for a single polygon are a desirable feature in the WD.WITHDRAWALS theme since the same piece of ground might be withdrawn by as many as six different Case Files. The attribute supplied to each polygon formed by Parcel Generator is simply the case number assigned to each Case File. Upon conversion to MOSS, ADS concantonated the attributes into a single subject.

The most time consuming ADS edit problem was that which was created when the same piece of ground was withdrawn multiple times by different Cases. The piece of ground may belong to several different parcel descriptions, resulting in numerous polygons having no attribute. The only way to sort out this chaos was with the Case File parcel descriptions by your elbow, and the 100k Surface Management quad on your lap. Each polygon had to be tracked down through the Case File parcel descriptions before it could be attributed correctly.

Some very strange parcel shapes were produced, at no fault to Parcel Generator, due to the irregular nature of the townships in this area. The Parcel Generator algorithm for aliquot part descriptions is based on a simple routine which halves township boundaries until the described parcel is broken out. If you start with an irregular township shape, you end up with an strange parcel shape. The only way to correct these parcels is by moving line endpoints to their correct position in ADS edit.

Parcel Generator Problems

The irregularity of townships in southern California provided other problems for Parcel Generator. One of these was the number of sections per township. Some townships in this area may have over sixty sections. At the time this project was in progress, Parcel Generator had an upper limit of 36 standard sections per township. This has since been increased to an upper limit of 99. Sections greater than the upper limit had to be hand drawn and digitized.

The Case Files in this project had many descriptions calling for interior lots. Parcel Generator does not do interior lots. Interior lots also had to be hand drawn and digitized.

At the start of this project, Parcel Generator could not do more than one aliquot part description per type 3 (aliquot part) record in an ORCA data file. ORCA data files are written with as many aliquot part descriptions in each type 3 record as will fit: typically up to four descriptions per record. During the editing of the ORCA files, it was necessary to break each aliquot part description into its own type 3 record to accommodate this bug. This problem was corrected after approximately 85% of the Parcel Generator work was completed.

Use and Representation of Final Products

Upon completion of the Parcel Generator process and all ADS edits, the resulting 100k WD.WITHDRAWALS parcel maps were themselves final products. However, to actually use the data in the GIS effectively, the ADS data files are converted / transferred to the MOSS data base. Here they constitute another finished product. Realize that there is one parcel map for each of the 19 100k areas. A single 100k parcel map may have as many as a dozen or so Case Files represented within its boundaries as designated by the Case Number subjects stored within each polygon.

The stated desired hard-copy output at the project's inception was individual Case File maps for each Case File occurring on a 100k parcel map. This translated into a 53 map set over the 19 100k Surface Management quads.

The failure to convince Lands not to eliminate the parcel boundaries interior to a section has in fact already caused problems. As negotiations have refined the Withdrawals (and therefore, the data), the GIS parcel maps have evolved into mere cartoons of what is being represented.

Since the parcel maps are now generally represented at 250k, 750k and 1000k scales the cartoon aspect is not as big a problem as may be imagined. At these scales, individual parcels are not usually distinguishable any way. The data was never intended by Lands to be used to determine acreage. Lands keeps this information current with their own records.

Summary and Conclusion

What Worked Well

The project was completed two weeks over the promised six, but well within the must-have date originally provided by Lands. Many things did not work as well as hoped, some not at all. But there are a few significant things that worked well.

When its published limitations are accepted, Parcel Generator worked well and as advertised. Problems with Parcel Generator are encountered when you try to push it beyond its acknowledged limitations.

The CPLs worked well most of the time. Though blamed for much because they bombed so often, most difficulties in running CPLs were caused by data problems - not the CPLs themselves. Let there be no doubt though, that there is much room for improvement of the CPLs.

The people heavily involved in the project worked very well, and very hard: particularly in Mapping Sciences where the real work was done. There were problems encountered in coordination and communication between Lands, Mapping Sciences, and IRM. These problems were really no more than might be expected on a project of this scale and relatively short time frame.

What Did Not Work

Data problems were the greatest difficulty. The required editing of the ORCA files introduced data errors into otherwise error-free files. Inconsistent coding of township attributes in the PUBLIC.GS theme, though small as a percentage of total incidents, caused a great deal of time loss. The general irregularity of the townships in the project area was also a problem, but one which was impossible to avoid.

Distributing the process to each individual ADS 100k project area did not work to advantage as expected. It would have been better to confine the processing to one "special" project and subsequently distribute the output. Many of the CPL bombs were caused by incomplete distribution of the necessary ADS input files among the 19 100k ADS projects.

What We Would do Differently

Compile your lists and cross references first and be more thorough than you imagine is necessary. Ours were under constant evolution as situations demanded. It would have been a great aid to have completed this early on, as the value of these lists cannot be over emphasized. You can expect to need more cross references than you initially anticipate.

Time estimates are rarely easy for something you have never done before - but try to be conservative and realistic. IRM estimated four townships per hour for any automated process. Fifteen minutes to run one township file through a CPL may sound reasonable, but it does not account for delays caused by bombs and such. You can fully expect that running

Ls will take more time than using ADS to edit townships and parcel maps.

Definitely do your ADS processing out of one "special" ADS project directory. This will reduce confusion and overhead in organizing and accomplishing the work. Distributing final output is probably not as daunting of a task as it appeared to us when considering this decision. Making the data generally available during the life of the project by processing in the established ADS projects was not worth the trouble: no one else used the data anyway.

Removing parcel boundaries interior to each section for each Case File has come to be greatly regretted. To repair this now is to nearly start all over. Live with the parcel boundaries as they make the data many times more valuable. It is also advisable to duplicate the original data set prior to making modifications. This will permanently maintain one complete original data set of parcel maps which you will need for a variety of modification variations.

We wish we had gotten the Lands section more involved with the process so that they may have obtained a greater sense of ownership of their data. It would have also been helpful for them to achieve a certain level of understanding about the GIS, its limits and its abilities.

Finally, we strongly recommend that you allow time for developing multiple attribute files. The final MOSS parcel maps should at a minimum have the township, range, and section attached to each parcel. These cannot be entered as part of the subject because the Case Numbers are used for this purpose and often consume nearly all of the 30 available characters. Having the section, township and range linked to each parcel would make finding individual parcels much easier than is now possible with our data.

Using MOSS
for Creating a State-Wide Atlas
of 7.5 Minute Digital Data
from "Geographic" Map Names

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INTRODUCTION

Although BLM (and other MOSS using agencies) have vast quantities of digital map data, until now there has been no easy way to produce an atlas showing which 7.5 minute USGS quadrangle maps are available, and what cartographic themes are available for each of the quads. This paper will present a MOSS method for using 7.5 minute map names that use the USGS map naming convention (see figure 1), to produce a state-wide atlas of available digital map data. The atlas will be created using a new fortran program called GEONAM2IMP, PRIMOS commands (or equivalent commands on other operating systems), MOSS import and multiple attribute commands. GEONAM2IMP.RUN should be found in the same directory as MOSS.RUN.

Using the PRIMOS SLIST -SNGCOL ADS.@@ in the ADS directory, a list of ADS.mapnames is created (see table 1A). Using an editor, the "ADS." is striped from each map name (see table 1B). If the data is in several directories, the files will have to be merged into one file. As an option, use the PRIMOS SORT command to put the file into sort order. This will speed up the MOSS multiple attribute resequence command. The file must be named GEONAME.LIST. In this example, there are 1846 valid names in the file.

A (ORIGINAL NAME)	B (EDITED NAME)
ADS.A137102	A137102
ADS.A137103	A137103
ADS.A137104	A137104
ADS.A137106	A137106
ADS.A137107	A137107
ADS.A137108	A137108
ADS.A137109	A137109
ADS.A138102	A138102
ADS.A138103	A138103
ADS.A138104	A138104
ADS.A138105	A138105
.	.
.	.

TABLE 1
CREATING INPUT TO GEONAM2IMP

A similar list can be made from MOSS map names. The suffix need not be removed since the program only the first 7 characters. It is important that the map name be in the file only once since each occurrence of a map name produces a polygon at the same geographic area. The PRIMIX uniq command, if available, can be used to remove duplicate map names from a sorted file.

Again using PRIMOS SLIST -SNGCOL @.menu.@, a list is made of each mapname.menu.X file in the ADS directory. These theme lists will be used to create a multiple attribute file. Names from multiple directories for the same theme must be merged into one file (see table 2). Again, as an option PRIMOS SORT the lists so that the map names will be in sorted order. In this example there are 1764 valid pls names, 1764 valid soils names, 255 valid stream names and 37 valid raptor names. The GEONAME.LIST file and the theme files can also be create from ORACLE tables.

```
A138107.SOILS.P
A139108.SOILS.P
A140108.SOILS.P
A140109.SOILS.P
A238107.SOILS.P
A239108.SOILS.P
A240108.SOILS.P
A338107.SOILS.P
A339108.SOILS.P
A340108.SOILS.P
A438107.SOILS.P
       .
       .
```

TABLE 2
INPUT TO ATTRIBUTE RESEQUENCE

A similar list can be made from MOSS map names. The suffix should be the same for each map name in the list.

Run GEONAM2IMP using the GEONAME.LIST file. The resulting file is in MOSS import/export format (see table 3). The coordinates are in latitude and longitude. The output file will automatically be named GEONAME.IMP.

```
      -1             A137102                    5
 -102.00000  37.00000
 -102.12500  37.00000
 -102.12500  37.12500
 -102.00000  37.12500
 -102.00000  37.00000
      -2             A137103                    5
 -103.00000  37.00000
 -103.12500  37.00000
 -103.12500  37.12500
 -103.12500  37.00000
 -103.12500  37.12500
 -103.00000  37.00000
      -3             A137104                    5
 -104.00000  37.00000
 -104.12500  37.00000
 -104.12500  37.12500
 -104.00000  37.12500
 -104.00000  37.00000
                  .
                  .
```

TABLE 3
OUTPUT FROM GEONAM2IMP

Use the MOSS import command to import the lat/long quads into MOSS. The projection must be lat/long.

Use the MOSS projection command to project the lat/long map into the desired projection. In this example it was state plane zone 3476, Colorado Central zone, and the map is named COLO.QUADS.

Use the multiple attribute commands to resequence each theme file (see table 4). Then add an attribute to the quad map for each theme file (see table 5). I suggest using one letter (e.g. the period in column 8 of the ADS.menu.X name) as the value of the attribute.

```
     A137102
     A137103
     A137104
     A137106
     A137107
     A137108
     A137109
     A138102
     A138103
     A138104
     A138105
     A138106
A138107.SOILS.P
     A138108
        .
        .
```

TABLE 4
OUTPUT FROM ATTRIBUTE RESEQUENCE

```
---------------------------------------------
ID TY ---KEY---- ---DESCRIPTOR---------------
 1 CH PLS        PUBLIC LAND SURVEY
 2 CH SOILS      AVAILABLE SOILS DATA
 3 CH STREAMS    AVAILABLE STREAM DATA
 4 CH RAPTORS    AVAILABLE RAPTOR DATA
---------------------------------------------
```

TABLE 5
DESCRIPTION OF COLO.QUADS ATTRIBUTES

MOSS select the appropriate state outline from MOSSDATA>USA32>STATES_USA. Reproject the state outline to the same projection as the quads map.

MOSS select the state map e.g. SEL COLO.OUTLINE.SP (ID 1).

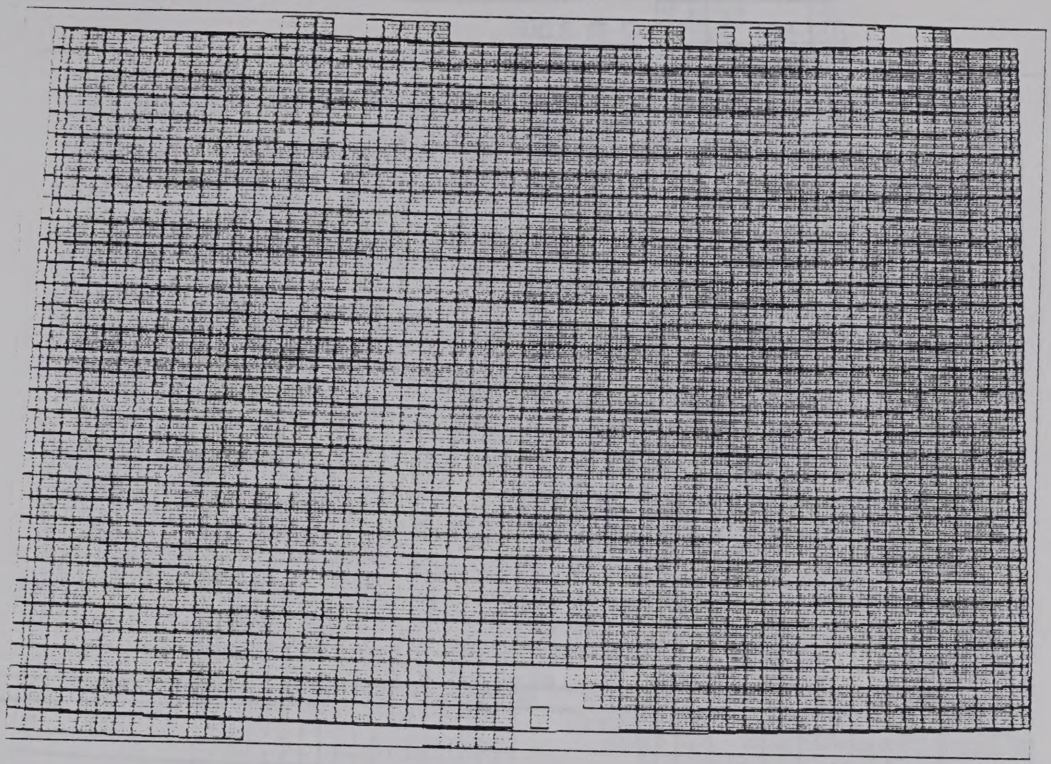
MOSS select all the quads. e.g. SEL COLO.QUADS ALL (ID 2).

MOSS bsearch the quads map for the theme of interest, e.g. BSEARCH COLO.QUADS, SOILS NE " " or SOILS EQ . or SOILS EQ "." (ID 3).

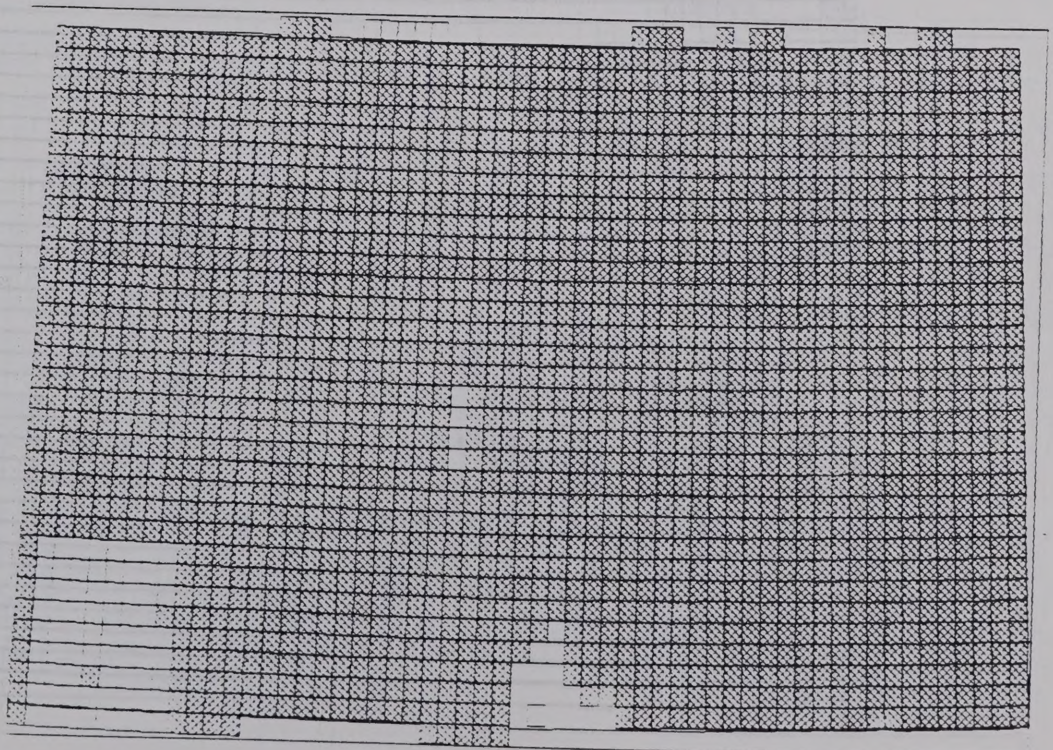
Use MOSS plot, penplot or COS to plot IDs 1 and 2, and to shade IDs 2 and 3 using different hatching and/or colors.

Repeat the bsearch and plotting steps for each available theme. When done you will have an atlas of all available digital data.

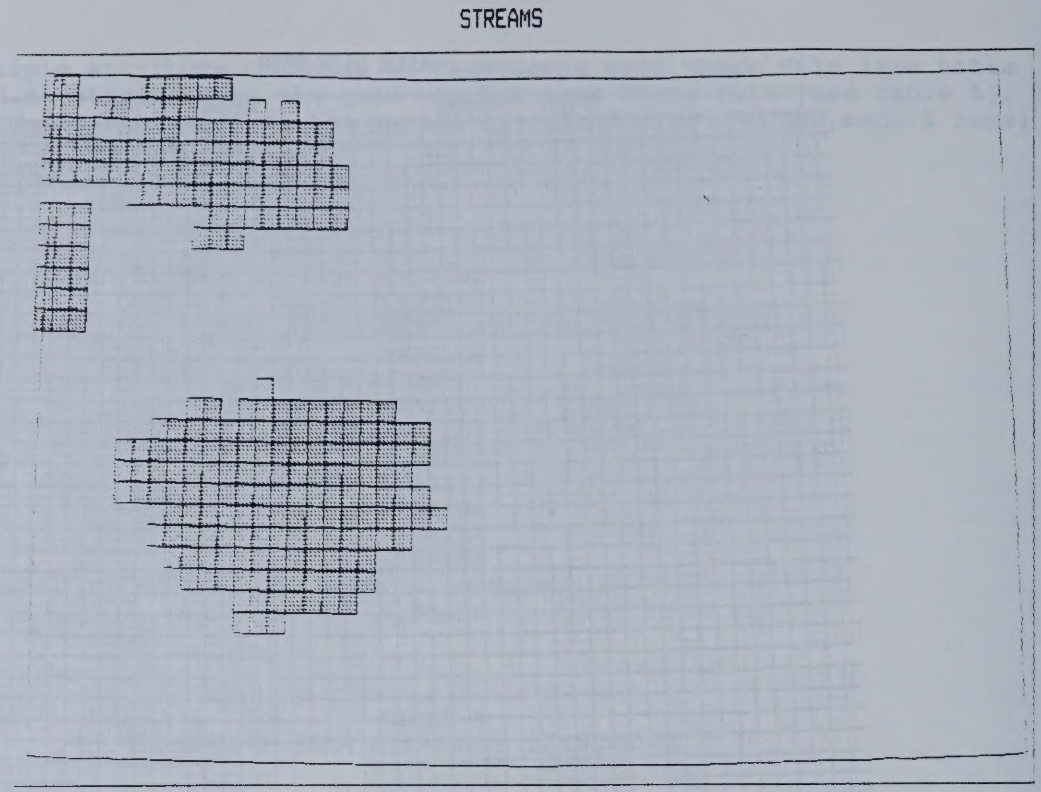
The following maps are examples of draft atlas pages.

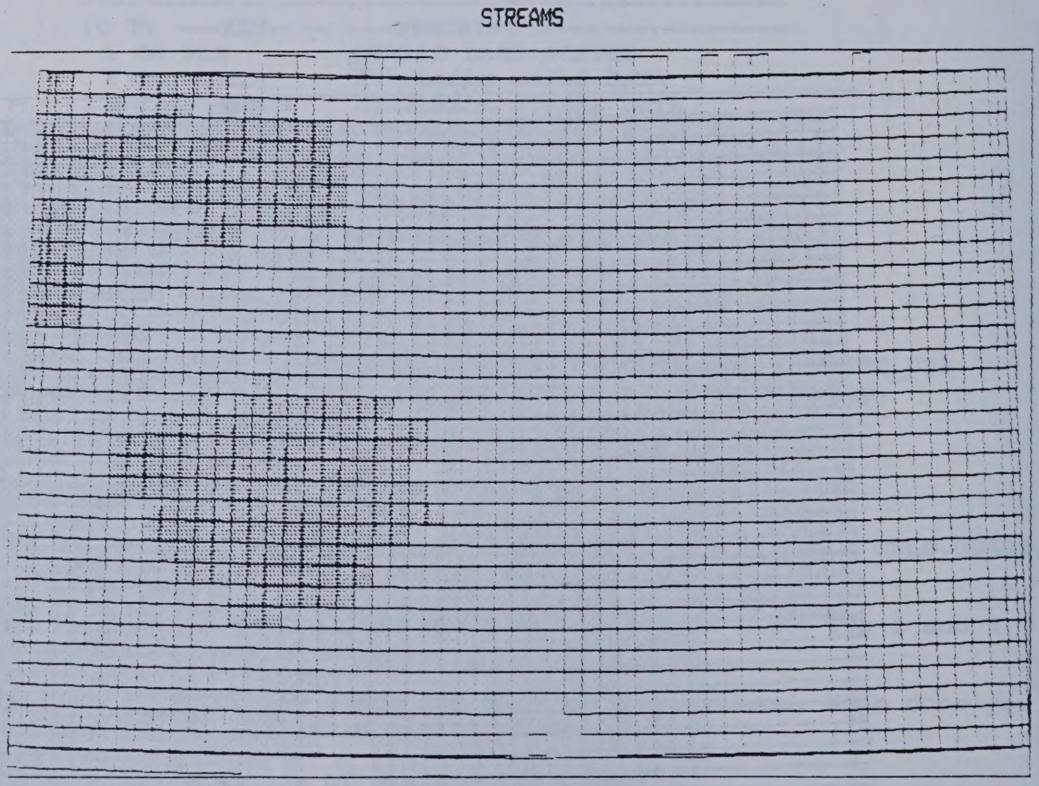


QUADS WITH DATA

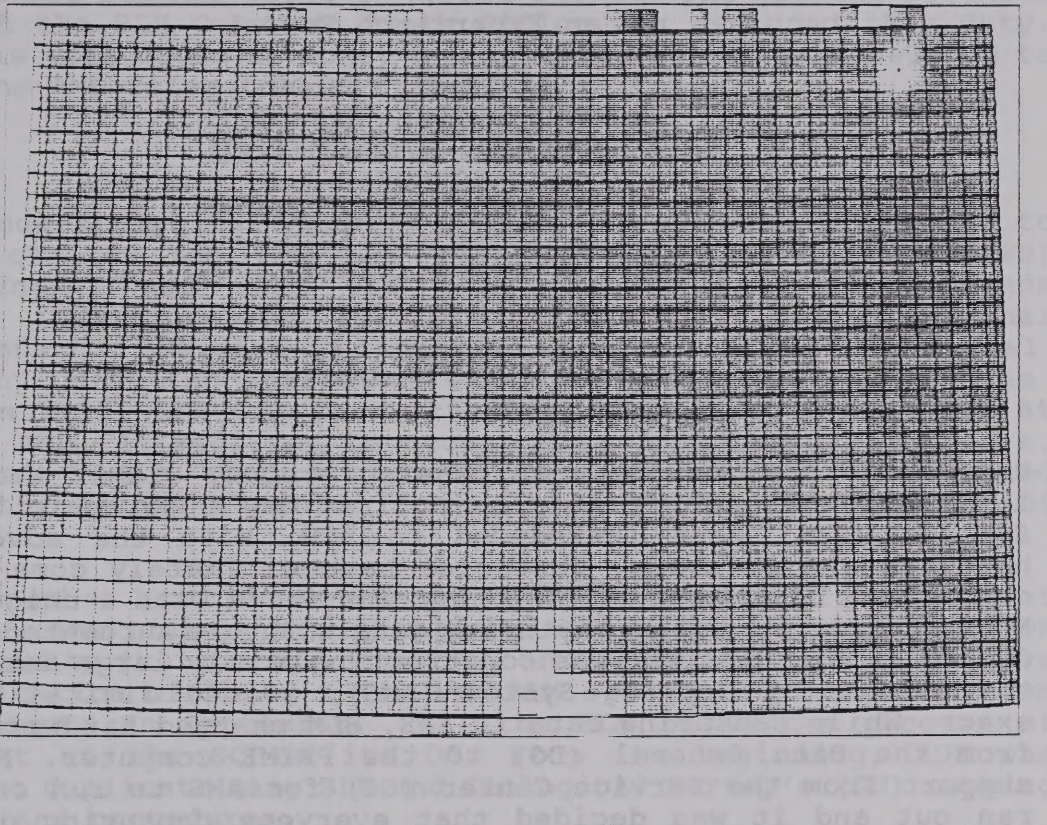


PLS

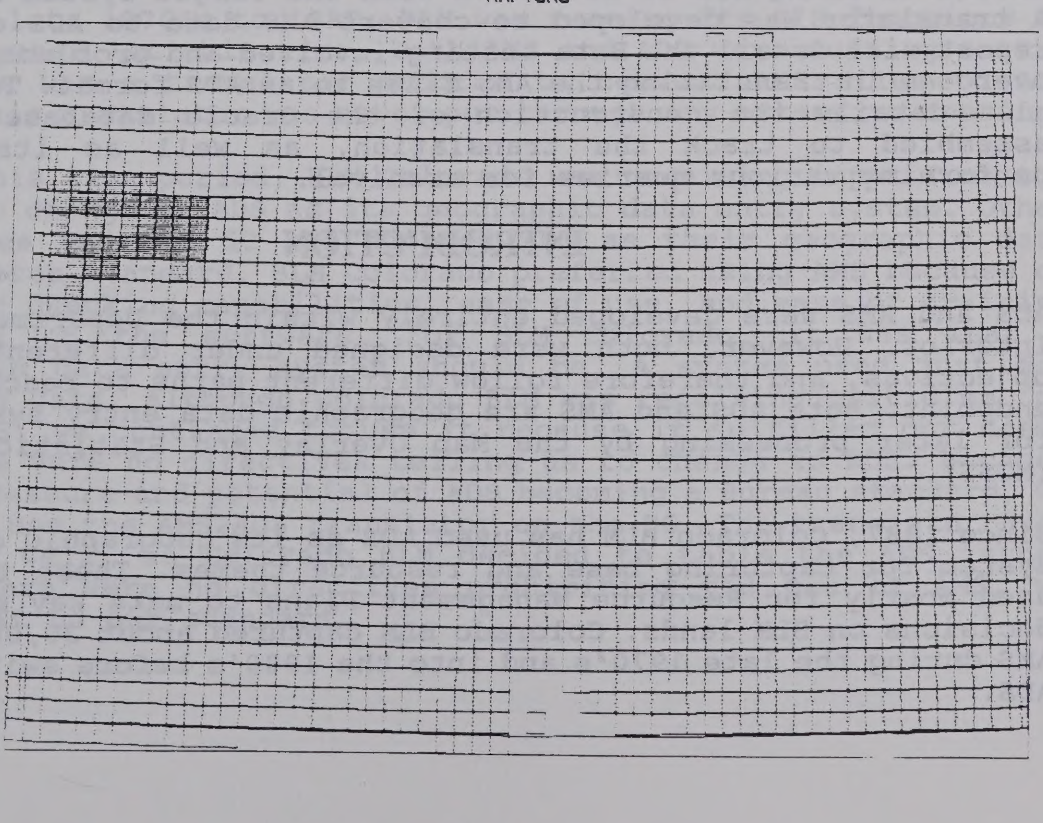

STREAMS


STREAMS

SOILS



RAPTORS



AMS2ADS CONVERSION for BLM COLORADO and building the ORACLE DATABASE TRACKING SYSTEM

an Experience Report

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ABSTRACT

Data conversion has been an ongoing process within the Bureau of Land Management (BLM) since the first day Geographic Information Systems (GIS) were introduced to BLM. With the advent of new hardware and software, obstacles have ultimately come about when converting digital data. Colorado was faced with a unique dilemma. Most other states were capturing data with the Automated Digitizing System (ADS). Colorado was constructing a very large database using the Analytical Mapping System (AMS), 20,000 digital maps to be exact. While capturing data in AMS, BLM changed hardware platforms from the Data General (DG) to the PRIME computer. Funding and support from the Service Center (SC) for AMS to run on the PRIME ran out and it was decided that everyone capturing data in BLM should be using ADS to be online with the Target System standards. A translator was developed to convert AMS data to ADS data. This report will detail the Beta testing involved and problems that were overcome in translating the AMS files to an ADS format. This report also details the construction of the Oracle database that was assembled to track the translation, as well as its uses in performimg various queries for archival.

INTRODUCTION

ADS and AMS were developed entirely within the Department of the Interior. However, both were designed under different sets of objectives, and therefore follow different paths to reach a common endpoint. Both ADS and AMS are geographic data entry systems used for later processing by the Map Overlay and Statistical System (MOSS).

Since 1987, Colorado BLM has used ADS as its geographic data entry system for capturing base and resource themes. These themes are used mostly for Resource Management Plans to make key management decisions on BLM lands. Colorado BLM captured about 20,000 maps in AMS during the late 1970's and into the 1980's before switching to ADS.

ADS is now the standard for BLM as a whole, so Colorado BLM needed to convert all its AMS files to an ADS format. The Mapping Sciences Section at the BLM Colorado State Office was assigned this duty. Before this work could be done, a translator had to be developed to convert the AMS files to ADS files.

HISTORICAL OVERVIEW

The Wetlands Analytical Mapping System (WAMS, since shortened to AMS) was created for the U.S. Fish and Wildlife Service (FWS) Western Energy and Land Use Team (WELUT) National Wetlands Inventory (NWI) project in 1976. Since 1976, the original applications for AMS were to center on wetland mapping from aerial photography using the Analytical Photogrammetric Plotting System (APPS). In 1978, AMS was re-written for the DG at FWS WELUT. At this time AMS was modified to accept data from table digitizers. WELUT soon began utilizing AMS in a production mode and subsequently became a center for maintenance and development of AMS.

ADS on the other hand was developed to meet a much different set of objectives. The primary application planned for a system like ADS was to automate the storage of survey and ownership data. I believe this application of ADS fit in with BLM's Land Information System (LIS) concept. In September, 1977 the BLM began the process of development at the SC on its DG. From its beginning, ADS was intended to duplicate many BLM and Geological Survey's (GS) mapping standards and procedures.

From the late 1970's to 1987, BLM was running its GIS functions on a DG Computer. At this time, both AMS and ADS were running on the DG. There was a translator program to convert AMS files to ADS files. This translator was never put through any extensive testing.

During this time period, BLM Colorado was receiving input from the BLM SC to change to ADS as its geographic data entry system. Other BLM States and the SC had adopted ADS as their geographic data entry system standard. BLM Colorado preferred using AMS because of its error checking capabilities, ease of use, and ease of training personnel on the software. For BLM Colorado, it was what a geographic data entry system should be, a system used just for capturing data. Although Colorado BLM was receiving criticism for using AMS, we continued to use it because it fulfilled our needs and there were no directives telling us to change to ADS. Because of the pressure and potential of ADS becoming a Bureau standard, we tried to use the AMS2ADS translator on the DG. The translator did not work well, so Colorado BLM decided to table the ADS issue. Since there were no directives prohibiting the use of AMS, we adopted it as our standard.

In 1987, BLM changed computer platforms from the DG to the PRIME computer. This entailed changing operating systems, program compilers, hardware and software, and converting data and programs in MOSS, ADS, and AMS so it would run on a PRIME computer.

To deal with this problem, Dr. Armando Guevara, a GIS Software Engineer with Environmental Systems Research Institute was designated as the project lead for converting the MOSS family of software from the DG to the Prime platform. In the introduction of Dr. Armando Guevara's technical paper (presented at the Fourth National MOSS Users Workshop), addressing this conversion process, Dr. Guevara stated:

"The objective of the software conversion effort was to convert the various geoprocessing software programs, i.e. MOSS, AMS, ADS, MAPS, COS, COS3, PROJECTION, REFORM and PENPLOT, from the Data General computer to the PRIME computer."

"This effort did not require that the software be enhanced, nor that problems in execution on the Data General be cured in the process of conversion on the PRIME."

"Case and Point;" in 1987, Colorado was informed that ADS would become the Bureau standard. ADS was said to be the format desired to go into the Target System. Colorado now had to deal not only with converting digital data from one hardware platform to another but also with converting already converted data to a different software format that had potential problems of its own. The AMS2ADS translator which resided on the DG was converted to the PRIME, and it was determined that the current AMS2ADS translator was not working well enough to attempt a mass translation of AMS files to ADS files. Thus a programmer at the BLM SC was assigned to make fixes on the existing AMS2ADS translator, while the Mapping Sciences Section at the BLM Colorado State Office was tasked to Beta test the corrected AMS2ADS translator.

BETA TESTING

It was decided that to test the AMS2ADS translator we would first need some data. A diversity of point, line, and polygon data and a diversity of data densities were selected upon which to perform our Beta testing. Soils, streams, land status, public land survey, as well as some site data were selected for testing. Three quads that covered these themes and data types were selected. The quads used were USGS 7 1/2 minute or 1:24,000 scale maps, since almost all the maps captured are at this scale.

The translator prompts are very basic. The user is first prompted to enter the AMS project name. This would be the source project i.e., where the AMS files to be converted are located. The user is then prompted to enter the ADS project name. This would be the target directory, i.e., where the user wants the translated files to be located after translation. The following prompts concern the themes, maps, scale, and projection. The translator can be used either in an interactive mode or a batch mode. The batch mode can be utilized by creating an ASCII file containing themes and map names to be converted. The Beta testing on the AMS2ADS translator involved both interactive and batch processes. Attachment #1 is a practice session on the AMS2ADS translator.

While Beta testing the AMS2ADS translator, many problems surfaced. Below is a list of some of the errors encountered:

- Missing attributes or misplaced attributes.
- Missing lines or misplaced lines
- Missing labels on lines
- Subscript range errors
- Border problems

These problems and more were dealt with through the standard bug reporting procedure i.e., find a problem, try to recreate it with a COMO file open, and submit the digital data files and digital COMO files with any supporting hardcopy documentation to the programmer. This systematic testing procedure worked well with the test data set but we still had problems with the more complex data, e.g., soils and streams. Because of time and money constraints, it was decided that the translator was as good as it was going to get and we would have to "workaround" the remaining problems as they arose. $20,000 had been spent on the development of the translator alone. Additional monies were expanded for Beta testing.

Before we could start the mass translation of the AMS files, all the AMS files on the DG would have to be converted to the PRIME computer. Only a small percentage of the AMS files had been converted to date. A program existed to convert DG AMS files to PRIME AMS files. This was an interactive program, run on the DG and the PRIME separately. It involved downloading data to tapes from the DG and reloading the tapes onto the PRIME to complete the process. It was a tedious and labor-intensive process involving the user entering commands and map names in a sequential order and maintaining close communication with someone in the computer room so he/she could watch the tape on the machine to make sure that space on the tape would not run out. If there was any mistake in this process, we had to start over.

Since a large amount of data had to be converted from the DG to the PRIME, a batch program was developed to automate the process described above, much like the program created to convert MOSS files from the DG to the PRIME.

It is important to note that during the development of this batch program to convert DG AMS files to PRIME AMS files the Mapping Sciences Beta testing team was not involved (In retrospect I believe this was a major mistake) and no testing was done on the converted files until after all the DG AMS files had been converted to PRIME AMS files.

All the DG AMS files had now been converted to the PRIME and mass translation through AMS2ADS could begin. What was not known, was that the programmer who wrote the batch process to convert DG AMS files to PRIME AMS files did not take into account the character-set differences between the DG and the PRIME that were associated with the line segment labels. When AMS2ADS conversion was started, ADS file labels were not showing up on the converted data.

By the time we noticed this problem, it was too late to turn back. All of the DG AMS files had already been converted to the PRIME. The programmer who had worked on this program had another job, and the DG was history. This necessitated a patch in the AMS2ADS translator. Luckily, the Mapping Sciences Section had a part-time Cartographic Aid, Kathy Rossmiller, who had just graduated from the Colorado School of Mines in Golden, Colorado. Kathy had extensive programming experience in both C and Fortran. Kathy, along with Wendy Tetley from the BLM SC, successfully made changes to the AMS2ADS translator to get the labels to translate with line segments.

This was not the only problem. When we started to mass translate the data, we now had new bugs in the translator that had not been evident previously. Border problems manifested themselves. When we started mass converting data, the data began drifting away from the original mapname.BORDER file. This bug was identified at a field office after a number of maps had been translated into a single project area. The Mapping Sciences Beta Testing Team was able to recreate this problem and Kathy made the necessary patch to correct it.

SUMMARY OF BETA TESTING

It should be noted that Beta Testing of the AMS2ADS translator was a long and tedious process. Once a problem was identified and documented, the bug was fixed, and in most cases, the data and or map where the problem occurred would translate. It is the opinion of this author that some of the problems of converting AMS files existed in the data itself and not the translator. Testing and retesting became critical. A close relationship through the process has to be maintained.

I believe it is important to note that the program was being compiled on the SC's PRIME computer and that we were using a different revision of the operating system than that of the SC. It is also important to note that some of the same problems that were corrected in one map would manifest in another map, no matter how much logic we applied to that problem during Beta testing. This was especially evident with the subscript range error.

THE ORACLE DATABASE TRACKING SYSTEM AND MASS TRANSLATION PROCEDURE

The Colorado State Office BLM decided it was time to start converting the AMS files to ADS files on the PRIME computer. Three things were needed before translation could begin. #1, We needed system resources, i.e., disk space. This was no problem because the Colorado State Office had just purchased a new disk. #2, We needed a tracking system so when it came time to dearchive ADS files, we could query the data in an automated fashion. I put together some Oracle tables to track the data conversion. #3, We needed trained personnel to convert the data and track what had been done. We hired three students to convert the data over a 3 month period working 20 to 40 hours each per week and I put together a 4 day training course on the AMS2ADS Translator, PRIMOS, EMACS, and Oracle SQL commands. Attachment #2 describes the fields in the Oracle tables. Attachment #3 is an example of one of the Oracle tables created through the AMS2ADS translation process.

The data in the PROJECT, THEME, and GEOUNIT_ID fields were constructed from existing ASCII data that were generated with COMO files during the translation of the DG AMS files to PRIME AMS files. The COMO file was edited via EMACS to delete header information and other extraneous data. Then, SQL load was utilized in Oracle to load the ASCII data into the Oracle tables. The other fields in the tables were derived from SQL commands and SQL script language.

These Oracle tables were originally built to track the translation process but other benefits have surfaced. The Oracle tables have been extremely useful for archiving and inventory purposes. COMO files can also be opened before going into Oracle to produce hardcopyies of the user’s query. In some cases, the ASCII data contained in these COMO files were used to aid in the mass translation procedure of AMS files.

With the Oracle tables set up and personnel trained, mass translation began. It was important to remember that when one converts a AMS map to ADS you end up with either a line or a point map. If you want to produce a polygon map, you need to run the polygon and closure routine in ADS on that map and clean up any errors that occur before importing into MOSS. In either case, special care should be exercised after conversion. If the map is a polygon map, running polygon and closure will force the user to some degree to conduct quality control on the map. If the map is a line or point map, the map in question should still be put through some means of quality control before importing to MOSS.

It was determined that because of the age and amount of data that were being converted, extensive quality control on an as-needed basis would be required by the owner of that data.

CONCLUSION AND BENEFITS

Mass translation is now complete for the 20,000 map files. It took approximately 3 months with 3 people working 20 to 40 hours per week to complete the process of translating and about another month to complete the Oracle table updates. It is my opinion that no data translator is perfect, for that matter most programs and/or software packages are not full proof, especially considering the following factors:

1. Translating data that was already translated from one hardware platform to another.
2. Translating such a large volume of data and expecting 100 percent translation.
3. Dealing with constant operating system revisions.
4. Dealing with several different programmers throughout writing, updating, patching, and documenting the translator software.

The benefits are clear.

1. No need to re-digitize 20,000 maps.
2. These data are now in a format that the Target System will accept.

SUMMARY

The AMS2ADS translator was developed to meet the need for converting AMS files to ADS files, much like what Dr. Guevara said in his paper (the effort did not require the files be enhanced during the process, just that they be converted to retain their original accuracy).

With the translation complete, I expect about 80 percent of the files were translated with no known problems. Considering the age of the most of the data and other factors involved, we feel lucky that that much was converted.

In addition Colorado BLM has gained a valuable Oracle database out of this exercise. In the past when someone wanted to know what data we had digitized, we resorted to looking through piles of computer printouts to find the maps in question. I believe we put these computer printouts to good use by loading these data into Oracle tables. Colorado plans to expand these tables to include data acquired through ADS.

REFERENCES

Fourth National MOSS Users Workshop Proceedings, MOSS PRIME Conversion Project, J. Armando Guevara, Ph.D.

A Comparison of FWS and BLM Geographic Data Entry Systems, Analytical Mapping System, Automated Digitizing System, prepared in cooperative effort by U.S. Fish and Wildlife Service and Bureau of Land Management.

The AMS2ADS Conversion Users Manual, by TGS Technologies, Inc. Denver Service Center, Bldg. 40 Lakewood, CO. 80225

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DISCLAIMER

It should be noted that the AMS2ADS translator is public domain software. The federal government makes no warranties, either expressed or implied with respect to the software. The use of any specific product name should not be construed or implied as endorsement of that product by the government. The information contained in this paper reflects the views, opinions and conclusions of the author and his sources and does not necessarily represent those of the Department of the Interior, Bureau of Land Management.

Attachment #1

Practice Session

To execute AMS2ADS, type the following at the Prime Operating System Prompt:

AMS2ADS

The following response will appear:

Enter AMS project name / database name:

Type in the AMS project name

Enter ADS project name / database name:

Type in the ADS project name

Enter AMS theme name ([CR] = end):

The theme names can be entered from the keyboard or from a ASCII file.

Keyboard Method:
Enter one theme name per question. When all theme names are entered, press the carriage return to continue.

File Method:
Theme names can be entered from a file instead of the keyboard. The format of the file must have only one theme name per line. For example, the theme file, THEMES.TXT, contains the names below:

```
SOILS
STREAMS
PLS
```

To specify theme names to be entered from a file, enter '@' followed by the theme file name. For example, using the theme file name above, THEMES.TXT, enter @THEMES.TXT.

Enter AMS map name ([CR] = end):

Entering more than one map name forces the program to run in batch mode, thereby limiting user interaction. This is discussed in a later section in the AMS2ADS User Manual.

Practice Session Cont.

The AMS map name can be entered from the keyboard or from a ASCII file.

Keyboard Method:
Enter one AMS map name per question. When all AMS map names are entered press the carriage return to continue.

File Method:
AMS map names can be entered from a file instead of the keyboard. The format of the file must have only one AMS map name per line. For example, the AMS map file, MAPS.TXT, contains the names below.

```
380310711
381110641
382610726
```

To specify AMS map names to be entered from a file, enter '@' followed by the map file name above. For example, using the map file name above, MAPS.TXT, enter @MAPS.TXT.

Enter existing ADS projection parameters file name. ([CR] = enter at keyboard):

The format of the file must be in a fixed layout. For example, the projection file, TEST.PROJ, contains the information below.

Projection code	Ellipsoid
UTM zone	Projection Unit
Projection numbers	1 - 5
	6 - 10
	11 - 15

The Projection code, ellipsoid, UTM zone, and projection unit are Integer*5 types. The projection numbers are Float*15.5 types.

To specify projection parameters to be entered from a file, enter the projection file name without any extension. For example, using the projection file name UTM.PROJ, enter UTM, the program automatically looks for UTM.PROJ.

The projection parameters can also be entered from the keyboard as follows:

Practice Session Cont.

Enter a carriage return (to the above question) to enter the projection parameter for the AMS maps and themes. You will have a choice of 20 projections. For further information refer to the ADS user's manual and/or Map Projections Used By The Geological Survey.

A file of the projection parameter you entered will be created and placed in the primary path for ADS. The following prompts will appear for the creation of this file.

Is the data in the western hemisphere ([CR = Yes):

If all of the AMS maps for a particular run are in the western hemisphere, then the answer to this question is Yes.

Any other character besides a Y (or y) will be interpreted as a No.

Enter NEW ADS projection file name:

The projection parameters entered at the keyboard will be written to a file. Enter the desired file name for the projection parameters. The program will automatically append the extensive .PROJ.

ADS Output File Names:

The ADS mapname will automatically be constructed using USGS map naming conventions as implemented by the BLM. This uses the geounit center (the latitude and longitude of the center of the map) and geounit size (distance, in seconds, from the center to the edge of the map). If the geounit center is 42 33' 45" lat. 109 33' 33" long. and the x & y geounit sizes are both 225 sec., the map name will be E542109. Each ADS map name also has an extension denoting the type of data contained within it. A .L means lines, .S means points, .A is attributes.

If the ADS mapname being created already exists and the AMS map to be converted is not a 7.5 minute quad then a letter will be appended to the front of the filename.

Oracle Field Descriptions

Attachment #2

AMSTAPE:	This field contains the tape name of where the AMS files are archived.
PROJECT:	This field contains the project name of the AMS files.
THEME:	This field contains the theme name for the AMS files.
AMS_FILE_NO:	This field contains the physical file number of where the AMS file is located on the AMS tape.
GEOUNIT_ID:	This field contains AMS map-naming convention.
DATE_CONV:	This field contains the date the AMS file was converted to an ADS file.
QUAD:	This field contains the first and second characters in the ADS map-naming convention.
LATLONG:	This field contains the third through the seventh characters in the ADS map-naming convention.
ADSTAPE:	This field contains the tape name of where the ADS files are archived.
ADS_FILE_NO:	This field contains the physical file number of where the ADS file is located on the ADS tape.

EXAMPLE OF ORACLE TABLE

```
SQL> SELECT * FROM PA11294;

AMSTAPE  AMSPROJECT  THEME  FILE_NO  GEOUNIT_ID  DATE_CONV  ADSTAPE   QUAD  LATLONG  ADS_FILE_NO
=======  ==========  =====  =======  ==========  =========  ========  ====  =======  ===========
PA11294  GLENWOOD    SOILS        2   380310703  08-JUN-91  ADS11644  A1      38107           21
PA11294  GLENWOOD    SOILS        2   381110703  08-JUN-91  ADS11644  B1      38107           22
PA11294  GLENWOOD    SOILS        2   381810703  08-JUN-91  ADS11644  C1      38107           23
PA11294  GLENWOOD    PLS          2   380310703  08-JUN-91  ADS11644  A1      38107           21
PA11294  GLENWOOD    PLS          2   381110703  08-JUN-91  ADS11644  B1      38107           22
PA11294  GLENWOOD    PLS          2   381810703  08-JUN-91  ADS11644  C1      38107           23
PA11294  GRHF        SOILS        3   401810818  08-JUN-91  ADS11644  C3      40108           24
PA11294  GRHF        PLS          3   401810818  08-JUN-91  ADS11644  C3      40108           24
```

Attachment #3

SUMMARY OF SPECIFICATIONS
DLG2ADS TRANSLATOR

General notes on DLG2ADS conversion needs:

BLM's GIS users have a need for a more fully developed and enhanced translator to take files in DLG-3 optional format (as prepared by the U.S. Geological Survey) and convert them into ADS files, with ADS line types, menu positions, fonts, pen assignments, and other parameters converted. The enhanced conversion software would also bring over certain types of point data, all line data, and also polygon attributes. Optimally, the converted file would be ready for immediate use within ADS (as if it had been captured in ADS). The narrative assumes that some type of Look Up Table (LUT) will be used in the conversion process.

The DLG layers for this conversion include Public Land Survey System (PLSS); Boundaries; Hydrography; Transportation; and Man-made Features. Often the transportation layer for a DLG consists of three separate files: roads and trails, railroads, and pipelines and transmission lines. There may also be cases in which two or more ADS layers are necessary to convert one DLG layer, for example, segregation of DLG hydrography single-line streams from double-line streams and water bodies in separate ADS themes.

The discussion here is based on the need to convert 1: 24,000 DLG's. While it is possible that many comments are also true for 100K or smaller scale DLG's, no specific attempt has been made to deal with scales other than the 24K. From conversations with users who have imported 100K and 1 :2,000,000 scale data, however, it appears that the major differences are with the major/minor codes (separate codes for the 100K, etc.), which are easily accommodated by the proposed look up table format.

The existing DLG2ADS conversion software (menu pick # 10 in ADS) provides some basic functionality. Based on our experiences within Idaho, the current software appears to do the following (list may not include all present capabilities):

> *Takes line data (coded "L" in DLG file) into ADS menus. All data is converted over into the user-defined menus as the 5th line type on the menu, whatever it may be.*
>
> *Brings over all lines in the DLG, including the lines which comprise only the "neatline" or border of the map and are not associated necessarily with any features. The current translator brings all such lines over, but flags them in ADS as deleted lines (identified with a minus sign in the .L file).*
>
> *Gives the user the opportunity to bring over labelled lines. The label that comes over is the major/minor code(s) that is associated with that line in the DLG.*

For landlines, the translator reads the major/minor codes in the area records (A) and places them as attributes in the ALMRS format, with hidden attributes (e.g., 03; 029N0030W). The translator does not make polygons, however.

For other themes with area (A) records in the DLG, the translator takes the major/minor codes and places them as the attribute name. For example, an intermittent lake would come into ADS with an attribute of 050 0421 050 0610. The x,y location is also converted into map inches in ADS.

Converts data that is coded in the DLG as degenerate line (DL) data and puts them as point (symbol) data in ADS. Points come over into ADS as labelled, whether or not the user requests for line labels to be brought over. The current translator apparently does not bring over features that are identified only as nodes but not as degenerate lines (i.e., identified with a major/minor code) . Some data is being lost in this manner.

The conversion assumes that no data for this quad currently exists, and so it builds a mapname.BORDER and a ADS.mapname file and creates other files (mapname.MENUS, .L.F files, etc.) It does not have the capability to use existing control. For quads with existing layers, a dummy name has to be assigned to the incoming DLG layer and then the newly converted file needs to be merged onto the existing control (using the ADS MERGE command).

The current translator hardcodes various values into the .S and .L files. For point data, the label width of 0.06 inches is hardcoded into the .S file for each feature, as is the label height (also 0.06"), the label angle (=0), and the font (=0). For line data, the same values are assigned (width of label= 0.06; height = 0.06; angle=0; font=0). It also appears that the height of the attribute text string is hardcoded as 0.10 inches.

It appears that the maximum length of characters to be brought over in a M/M string is 24. If the number of pairs exceeds this length, it appears that the data may be truncated, although no examples were found in the sample data.

The existing software leaves a file that requires substantial editing, especially through mass modifying. Individual lines must be modified to have the desired ADS line number in the menu. For line data, labels must usually be changed into an alphanumeric string, or deleted altogether. It is also often necessary to change the width, height, angle, and font for the labels of each of the point and line features brought over in the translator.

Specific requirements (mandatory):

o **convert DLG lines to respective lines in ADS menus**

The basic requirement is to convert line (including degenerate line) data from the DLG's into the mapname.menuname.L and mapname.menuname.S files using user-specified menus. The particular major/minor (hereafter abbreviated as M/M) codes for each line in the DLG file need to be converted into the proper positions as defined by the respective ADS menu. For example, if the first pick for lines on the ADS menu is "intermittent stream" (see enclosed menu), then all lines in the DLG file containing a M/M code of 050 0412 050 0610 would be brought over as line pick 1 on the ADS menu . For line data, the pen number, line width (line separation distance for "double" lines) and the line length (repeat value) are defined in the menu and are unaffected by the translator.

o **convert point data to respective position on ADS menu**

This is similar to the requirement above for lines, only the data would be defined by "picks" on the left hand side (symbols definitions) of the menu. For point (symbol) data, the existing definitions for pen number, symbol angle, symbol height, and symbol width (for the symbol itself, not for the label) are defined in the menu and are unaffected by the translator.

o **provide flexibility for labelling of points, lines**

The translator needs to provide a way for the user to specify during conversion the types of choices available in a normal capture or edit session, including the choice of the labels' height, width, pen, slant, and font. (This is different from the height, width, pen, and font for the symbols or lines themselves). These label values can be incorporated into the LUT.

o **allow for transfer of lines from one DLG layer to two or more ADS menus.**

DLG files often contain both line and polygon data. For example, the hydrography layer contains linear data (single line streams) and polygonal data (lakes, reservoirs, other water bodies). The translator should recognize M/M codes for the respective types and be able to place them in the respective ADS menus, although not necessarily in a single pass.

- **Allow for transfer of lines from various DLG layers into one ADS menu.**

  The translator would allow appending to an existing file. For example, a range improvements menu might need spring/well data from the hydrography layer and other data from the man-made features layer. The translator would allow data to be appended to the existing range improvements file.

- **Allow for DLG's to be entered in any order**

  The translator must be set up so that any DLG layer can be read in. In some cases, the PLSS might be the first layer read in, boundaries the second, hydrography the third, etc. In other cases, the user may want to input the hydrography layer first.

- **Allow for polygon attributes to be converted**

  At the present time, only polygon attribute information from the PLSS layer is converted over and becomes a value similar to data digitized directly in ADS (e.g., 03; 029N0030W). The current translator will bring across other polygon attribute information, but keeps it in its M/M code. The enhancement will use a LUT to convert the M/M code to a user-defined attribute (e.g., M/M code of 050 0101 would have the attribute of "RESERVOIR.") In addition, for the attributes that are converted over, the conversion software should allow the user to specify 5 parameters: height, angle, pen, slant, and font. These values can be incorporated into the LUT.

- **Allow for transfer of data onto quads with existing ADS data:**

  As indicated above, at the current time, the translator does not provide an option that allows the user to bring new layers into a quad with existing data, i.e., one which already has a mapname.BORDER, ADS.mapname, and associated files. The enhancement would allow the user to specify if there is existing registration and header information, and would utilize that information. It would also allow for additions to the mapname.MENUS files.

- **Design translator so conversion can enhance future ADS2DLG work**

  The present DLG2ADS conversion detailed here should be designed as much as possible with the idea that the conversion can work in the other direction, that is, from ADS to DLG. The idea is that the software and LUT's can be used to take data originally captured in ADS format and place it into DLG format, with M/M codes. For example, if ADS menu line pick # 3 is for intermittent streams, the translator would build the normal nodes-areas-lines format, while at the same time assigning the M/M code of 050 0412 050 0610.

[It is recognized that there are many other factors which are required to bring an ADS file to full USGS specs, most of which have to do with the manner in which data was captured. The idea, however, is that the same LUT could be used to build a "rough" DLG file which then could be heavily edited (using other non-MOSS family software) and made into a full DLG.]

o Use ASCII LUT's that users can easily create/edit

The LUT's that are built as part of this program should be in ASCII format, to permit easy editing through EDITOR or EMACS. At the same time, the program should provide an interface for building the LUT prior to the initialization of the DLG translation. This could be a macro/program capable of being run separately from the translator, but should be accessible/used during the translator session as well.

Known complications:

1. Point data. At the present time, the translator brings across degenerate lines (2 coordinate pair lines, with the same first and second x,y coordinates) and places them as point data in an ADS file (technically, builds a .S file.). A typical example might be windmills or springs. It appears that degenerate lines (in the "L" section of the DLG) are already often identified in the node "N" section of the DLG, with the same geographic coordinates and the respective M/M code. In some cases, however, features are identified only as nodes but not as degenerate lines. One known situation is for springs which are shown as part of a watercourse (not isolated springs, away from streams). These springs are M/M coded as nodes but not as degenerate lines. As a result, with the current translator, these features do not come over into ADS. The remedy would probably be to read all nodes that have M/M codes, compare them with the data read for the degenerate lines, and throw out the "duplicate" occurrences. In this manner, springs identified only as nodes but not as DL's would still be translated over, and any springs already appearing as DL's would have only one coordinate pair translated over.

2. There are some different codes which are found in older files, specifically hydrography (pre-1983), transportation (pre 1985). The conversion program would have to take these into account. The LUT approach should solve most, if not all, of this problem, since the user must be aware of the older codes and design a LUT accordingly.

3. The number of M/M codes varies widely, from a single pair to often four or more. The program must be flexible enough to read and interpret all codes and make a decision accordingly. There are at least 5 known types of situations.

   a. There are many situations in which the entire string of M/M must be read to determine the proper meaning. This is the result of the fact that some M/M codes are for feature identification, others are descriptive, and still others are parameters (with values, such as the river mile number.) For example, an intermittent stream is usually identified as a "stream, intermittent" (050 0412 050 0610). Both M/M codes must be read. If nothing more than the first M/M code were read, the stream would be (by default, that is, lack of any modifier) a perennial stream. In other words, there is no code for stream, perennial -- a code of 050 0412 without additional M/M codes means that the stream is indeed perennial.

   b. Possible "wildcarding." There may be instances in which the occurrence of a particular M/M code anywhere within the character string is sufficient to place it within a certain line in the menu. For example, in the transportation layer, a code of 170 0603 (under construction, classification known) is sufficient to assign this line as line #8 in the Idaho GTRANS menu, regardless of any other coding that might be present. The translator must (somehow) be able to interpret this information, or allow for some type of a wildcard character in the user-built LUT.

c. Variables contained in M/M codes. Some M/M codes have 1 or 2 "set" characters, followed by an attribute value. One example are 055 xxxx, which contains the river mile number (hydrography) in four spaces, right justified (e.g., 055 0241). Another example is in the boundaries layer, which carries the state FIPS code (e.g., 091 0016 for state = Idaho). The software must be able to extract the values from these variables.

d. There are M/M codes for nodes, areas, and lines. Some M/M codes are exclusively for one of the three. Other M/M codes, however, are multiple element types, which can serve as modifiers for any of the three types.

e. Sometimes the codes, especially the major codes, are shown with a preceding zero in the USGS documentation, but the actual files as loaded onto the Prime show a leading blank character. The software would have to accept either a zero or a blank.

4. The point, line, and attribute data in the LUT necessary for the conversion is somewhat different for the three data types, and may require the use of either separate LUT's per data type per menu or some type of "composite" LUT for each menu. For example, points and lines may require labels, while polygon data will require attributes. Also, a "pick" for point data will refer to the left side (symbol) of an ADS menu, while a "pick" for line data will refer to the middle section of the menu. Hence it may be difficult, in one table, to differentiate between a M/M code for a symbol number and perhaps the same M/M code for an ADS line number.

5. It should be noted that the DLG's carry some degree of cross-referencing to other layers where applicable (for example, a road on the transportation layer that coincides with a section line on the PLSS layer). The M/M code in each respective layer will carry a coincident feature number (often ending in 7 or 9), plus the major code (but not the minor) to which it refers. For example, within the PLSS layer, a section line that is also a road is identified as 309 0170 (coincidence with major code 170, transportation). Note that the reference only goes to the major level; there is no reference to the minor level (e.g., unimproved road).

[This makes sense, since a subsequent change to the road (say it's paved later) requires an update only to the transportation layer, not the one or other layers which have been flagged as coincident. As a result, there is no concern for bringing over duplicate lines, as originally thought could be the case.]

Possible translator design:

Since the translator must account for a huge variety of ADS menus throughout the Bureau, one approach might be to make 2 associated routines, the first to build a type of utility for the user to make a look-up table with equivalence values (e.g, M/M code of 050 0414 or 050 0415 = ADS menu line 4 on the Idaho GSTREAMS menu, M/M code of 050 0414 and 050 0610 = ADS line 5, etc).

> [An alternative to the utility might be reliance on the user to build the LUT in EDITOR or EMACS, using some type of a template.]

The second routine would be to access this (these) look-up table(s) and make the actual conversion to ADS format. Under this scenario, each menu would have its own look-up table, which could be accessed by name. It would probably be unwise to hard-code these values into an actual program.

Our recommendation is to design the software so that the user can specify one ADS menu at a time, read in the DLG file and have the ADS line assignments made. On a second pass, another ADS menu could be specified (with its particular look-up table), and the same DLG file read in. The result would then be that only the values from the DLG that are found in the second look-up table would be converted over. An example would be the DLG for hydrography. On the first pass, the ADS menu GSTREAMS (single-line streams) would be used. Codes corresponding to single-line streams would be in the LUT and therefore would be converted. On a second pass, the ADS menus GLAKES (lakes and all water bodies (i.e., polygons) would be read in.

> [An alternative approach might be to run a varying number of menus in one "integrated" session. In this manner, a number of ADS menu files might be open at the same time, and the program would proceed line-by-line in the DLG and branch into the desired menus. This would probably be far more difficult to program. It might also have the disadvantage of being more difficult for the user to verify where different DLG lines have been assigned.]

The present translator converts over but flags as deleted lines all the lines that comprise the neatline (map border). Perhaps this should be changed to give the user the option of bringing over such lines as deleted lines or simply not converting them at all. [not sure of all the implications involved.]

After much deliberation and thought (??!!), it was concluded that probably the best way to ensure that all data are converted over or at least flagged is to build the look up tables in such a way that virtually all common occurrences of M/M codes are accounted for in the table. If a particular M/M code is not to be converted over to a particular menu, then it should still appear in the LUT but have a blank or a zero in the field which indicates the ADS line (symbol) pick it should be assigned.

It is also recommended that the LUT contain an abbreviated definition for each M/M code listed, as a help to the user in editing these LUT's. This information would probably not be used by the actual conversion, but would be a big help, especially to the occasional user, who would otherwise need to have the USGS M/M code list handy at all times. [The definition of the M/M code is different from the labelling or attributing, which is an essential part of the conversion.]

For unrecognized codes, the program could prompt the user for what action to take, and possibly function much like a word processing spell checker (e.g., add the code to the table, ignore it once, or skip all subsequent occurrences of that code in the session.) Another alternative might be write all such unknowns to a default line/symbol type and label them with the M/M code or a "fix-me" label.

A third alternative might be to ignore unknown codes and produce a written "exception" report, indicating the DLG line number and the M/M code. The disadvantage of this report might be, however, that the user would have to re-run all the data again if the data were needed in that file. In this case, perhaps the translator should have the capability to overwrite files if a "repeat" session becomes necessary.

A possible design for a point LUT (for hydrography=single-line streams) is given below (to work with Idaho ADS menu GSTREAMS):

(Major/ minor code)	Definition	(ADS menu symbol #)	(Label height,slant pen,font)	(Label)
050 0300	Spring	2		(no label)
050 0301	Non-flowing well	1	00.07 00.00 1 1	WELL
050 0302	Flowing well	1	00.07 00.00 1 1	WELL
050 0303	Riser	1	00.07 00.00 1 1	WELL
050 0304	Geyser			
050 0305	Windmill			
050 0306	Cistern			
050 0400	Rapids	4	00.07 00.00 1 1	SMALL_RAPIDS
050 0401	Falls	3	00.07 00.00 1 1	SMALL_FALLS
050 0402	Gravel pit w/water			
050 0403	Gaging Station			
050 0404	Pumping station			
050 0405	Water intake			
050 0406	Dam or weir			
050 0407	Canal lock/sluice gate			
050 0408	Spillway			
050 0409	Gate			
050 0410	Rock			
050 0411	Crevasse			
(list could go on....; below are sample pre 1983 codes				
040 0300	Spring	2	00.07 00.00 1 1	(no label)
040 0301	Non-flowing well	1	00.07 00.00 1 1	(no label)
040 0302	Flowing well	1	00.07 00.00 1 1	(no label)
040 0353	Riser	1	00.07 00.00 1 1	(no label)
040 0356	Geyser			
030 0356	Gaging station			
030 0357	Pumping station			

A possible design for the line LUT (single-line streams, for Idaho menu GSTREAMS) is given below:

(Major/ minor code)	Definition	(ADS menu line #)	(Label height,slant, pen,font)	(Label)
050 0412	Stream (peren)	2		(no label)
050 0412 050 0610	Stream,interm.	1		
050 0413	Braided stream	3		
050 0413 050 0610	Braided stream,interm	3		
050 0414	Ditch or canal/peren.	4	00.07 00.00 1 1	CANAL

050 0414 050 0610	Ditch or canal/interm.	5	00.07 00.00 1 1	INT_DITCH
050 0415	Aqueduct (perennial)	4	00.07 00.00 1 1	AQUEDUCT
050 0415 050 0610	Aqueduct (intermitt)	5	00.07 00.00 1 1	AQUEDUCT
050 0416	Flume	4	00.07 00.00 1 1	FLUME
050 0416 050 0610	Flume (intermitt)	5	00.07 00.00 1 1	FLUME
050 0417	Penstock (perennial)	4	00.07 00.00 1 1	PENSTOCK
050 0417 050 0610	Penstock (intermitt)	5	00.07 00.00 1 1	PENSTOCK
050 0418	Siphon	10	00.07 00.00 1 1	SIPHON
050 0420	Wash or ephm. drain	8	00.07 00.00 1 1	WASH
050 0420 050 0610	Wash or eph. drain	6	00.07 00.00 1 1	DRAIN
059 00aa	Coincident feature	10	00.07 00.00 1 1	COINCID_FEAT

A sample LUT for line data (for water bodies, Idaho menu GLAKES) is given below:

(Major/ minor code)	Definition	(ADS menu line #)	(Label height,slant, pen,font)	(Label)
050 0200	Shoreline	3		(no label)
050 0201	Manmade shoreline	3		
050 0202	Closure line	3		
050 0203	Indefinite shoreline	3		
050 0204	Apparent limit	3		
050 0205	Outline Carolina bay			
050 0206	Danger curve			
050 0207	Apparent shoreline	3		
050 0209	Low water line			
050 0299	Processing line			
050 0605	Right bank	1		
050 0606	Left bank	1		
050 0605 050 0610	Right bank, interm.	1		
050 0606 050 0610	Left bank, interm.	1		

A sample LUT for area data (for water bodies, using the Idaho menu GLAKES) is given below:

(Major/ minor code)	Definition	(Attribute height,angle, slant,pen,font	(Attribute)
050 0100	Alkali flat	00.07 000.00 00.00 1 1	ALKALI FLAT
050 0101	Reservoir	00.07 000.00 00.00 1 1	RESERVOIR
050 0102	Covered reservoir	00.07 000.00 00.00 1 1	RESERVOIR
050 0412	Stream (doubleline)	00.07 000.00 00.00 1 1	RIVER
050 0412 050 0610	Stream (doub, interm)	00.07 000.00 00.00 1 1	INT_RIVER
050 0421	Lake or pond (perenn)	00.07 000.00 00.00 1 1	LAKE
050 0421 050 0610	Lake or pond (interm)	00.07 000.00 00.00 1 1	INT_LAKE
050 0421 050 0614	Lake or pond, dry	00.07 000.00 00.00 1 1	DRY_LAKE
050 0414	Ditch or canal (peren)	00.07 000.00 00.00 1 1	DITCH
050 0414 050 0610	Ditch or canal (interm)	00.07 000.00 00.00 1 1	INT_CANAL
050 0414 050 0616	Ditch or canal, navig.	00.07 000.00 00.00 1 1	NAV_CANAL
050 0415	Aqueduct	00.07 000.00 00.00 1 1	AQUEDUCT
050 0416	Flume	00.07 000.00 00.00 1 1	FLUME

Sample prompts from translator:

(Program prompts in bold; user responses are in caps)

Name of input file: RJN021F11 *(allow for full pathname, doing away with the necessity of having all DLG files in the same ADS directories. Users often wish to access DLG's out of a separate import directory.)*

Name of ADS map: D542112

Name of ADS menu: GSTREAMS

[program then checks to see if other layers already exist for this same map (ADS.mapname and mapname.BORDER already exist.) If it does not, it queries the user whether he/she wants the map built. If the map already exists, the program then checks to see if there is already data captured for that menu. If it does, it prompts the user to confirm that the new data from the DLG will be appended to the existing file (.L file), or allows the user to overwrite the existing .L file, or gives him/her an opportunity to loop back to the "Name of ADS menu" prompt.]

This map has no ADS data. Do you want to create D542112?
(N response will loop back to prompt asking for name of ADS map)
(Y response will allow program to continue)

OR **This map already has ADS data for other layers. Now adding data into STREAMS.** (menuname)

OR **This map already has GSTREAMS** (menuname) **data. Please select option:**

1. **Append new DLG data to existing GSTREAMS file**
2. **Overwrite the existing GSTREAMS file**
3. **Specify another ADS menu.**

[program then checks to see if a menuname.LUT already exists. If it does, program will ask user to confirm. If not, program will prompt for another LUT to use, or allow creation of a new LUT].

A look up table does not exist for this menu. Please select option below:

1. **Use another look up table**
2. **Create a new look up table**

A look up table GSTREAMS.LUT exists for this menu. Please select option below:

1. **Use another look up table**
2. **Create a new look up table**

3. Use the above table as it is now.
4. Edit the above table before proceeding

[if 1: user inputs the actual name of the input file.

[if 2: program allows for creation of new table, prompts users for entries, places data into proper fields.]

[if 3: program continues on]

[if 4: program opens the LUT and allows user to add, modify, etc.

```
Now beginning DLG2ADS conversion .......

     Map is ARBON, ID
     Source scale is 1 :  24000.
     Theme is GSTREAMS
          xx    ATTRIBUTE RECORDS PRODUCED
          XX    LINES PRODUCED
          XX    POINTS PRODUCED
```

[with abnormal termination .. error messages, if error can be trapped; otherwise user will get an ER! prompt at the PRIMOS level.]

Do you want to convert another layer for this same map? (Y/N)

[Y loops back to prompt for DLG filename, but does not re-prompt for ADS mapname; N proceeds on]

Any more files to convert? (Y/N)

[Y loops back to prompt for DLG filename and prompts for new ADS mapname; N exits the conversion program and takes user back to the main ADS menu.]

Specific requirements (good to have; cost may be too great):

o **Take DLG area M/M codes and "tag" to lines in ADS:**

In ADS, users often wish to have line types defined for cartographic purposes, in order to place onto output maps. They may want to differentiate, for example, between county lines and Forest Service boundary lines, and have separate line entries in menus to capture data in this manner. The problem is that apparently much of this type of information is contained within the area records of the DLG. County and Forest Service boundaries, for example, are coded to the areas, but not to the individual lines (arcs) that comprise the area. The translator would need to determine which lines are true boundary lines, so the data could be recognized by the program (via a LUT for line codes) and brought into ADS.

Another example would be township and section lines. Many times users want to work with just the township lines (e.g., in a small scale map where showing sections would make the map too busy). Many states have ADS menus on which township/range lines are a separate pick from other section lines. In the DLG, there is apparently no differentiation between section and township lines as lines. The information is contained within the area descriptors.

A third example is for hydrography. Users may wish to code lines to a "RESERVOIR" or "DRY LAKE OR POND" pick on the menu, but the DLG line data only portrays a generic shoreline, whereas the DLG attribute contains the needed information showing that these lines form part of a reservoir, dry lake or pond, intermittent lake or pond, etc.

The algorithm may have to be fairly complex, to cover various types of situations:

a. For township/range lines, the program would probably have to make some search rules for sections 1-7, 12, 13, 18, 19, 24, 25, 30-36 [and this would only work on normal 36-section townships]. The algorithm would probably test "area right - area left" (e.g., if area identified is for section 32, then the program would search for section 5 in the next township to the south and would identify the common line between the two sections.)

b. Another situation is where values, such as county boundaries, are continuous over the area (i.e, land lies within one county or another, but definitely lies within some county.) The "area left - area right" search could find the line(s) involved.

c. A third situation occurs when there may be an attribute value left but not right (or vice versa). For example, the area left may be the Boise National Forest, the area right blank or null (i.e., not a Natl Forest).

d. A fourth situation may be one in which an area attribute is given, but covers the entire quad. For example, a quad in the middle of a large county would be area coded as Owyhee County, but no actual county boundary lines are present on the map.

o **Allow for reversing the order of coordinates in a line:**

The DLG's may have been digitized in any direction. For lines which the user wants to have labelled, this may cause the label to be written backwards or upside down. For cartographic reasons, it would be beneficial to have a utility to reverse the order of coordinates in lines. This could (and perhaps should) be incorporated as a separate ADS utility and not necessarily done within the DLG2ADS translator. It is possible that the alternative solution (to not allow upside-down or backwards labelling) may solve this problem.

November 6, 1991

SESSION 3: GIS DATABASE CREATION/MIGRATION

WEDNESDAY, DECEMBER 11, 8:00 AM - 11:30 AM

SESSION CHAIRPERSONS:

Loretta Sharp and James Gazewood

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GIS ACTIVITIES IN OREGON

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ABSTRACT

Oregon's use of MOSS/MAPS software has been very broad and complex beyond the initial Resource Management Plan (RMP). With the biological diversity of Western Oregon forests, habitat is of large importance. One spotted owl project looked at specific site locations and analyzed the forest fragmented landscape within a 2.1 mile radius of nest sites. The Fish and Wildlife's listing of the spotted owl under the Endangered Species Act has kicked off many scenarios that are analyzed within the MOSS/MAPS software package. Many display products are created to show impacts of the various management strategies, along with acreage analysis as to impacts on timber sales.

BLM's GIS has also been used to serve as an informational platform to a school district to see how CoosBay Wagon Roads (CBWR) land was going to be managed. This was of direct interest to them, since their district's budget includes some timber revenues off this land. Several thematic data layers were plotted at a scale of 1:250,000 to meet their request, along with acreage tabular information.

Several environmental groups have requested special plotting projects showing current timber information, transportation networks and timber productivity classifications, along with some acreage information. Project such as these that meet public inquires will be presented to show how GIS in Oregon is being used in parallel to RMP developments.

Editor's Note: The presenter may forward proceeding related materials before this talk is given. These materials were unavailable at the time of publication for these proceedings.

DESIGNING THE FULLY AUTOMATED DATA FACTORY USING NETWORKED LTPLUS WORKSTATIONS

David Mandel
Infotec Development Inc.
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ABSTRACT

LTPlus has proven to be a highly efficient tool for capturing and editing scanned map manuscripts and for translating digital GIS data from one GIS to another.

In this paper we explore ways of putting LTPlus to work in a large established ADS and MOSS/MAPS installation. In particular, we will discuss ways of passing information transparently between PRIME and UNIX environments and from one UNIX workstation to another. We will demonstrate ways of using a PRIME computer to transparently perform computational tasks for LTPlus and vice versa.

Finally, we will look at ways of organizing these techniques to capture and edit large volumes of data. This involves building an Automated Data Factory which makes use of automatic conveyer belts and robots to perform long boring tasks.

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CREATION OF A DERIVED THEME

FOR MOSS USING LTPLUS

Daniel Haskell
Scott Oerding
Infotec Development Inc.
Portland, Oregon

Paul Cooler
USFS Fremont National Forest

ABSTRACT

Due to it's ease of use, flexibility, and power LTPlus has become an increasingly popular data capture engine. However, many GIS professionals have had doubts about the usefulness of LTPlus in maintaining or modifying existing data. This paper details an example of the use of LTPlus in the creation of a derived theme for MOSS. The history, intended use, and capture of a capability theme from MOSS digital and hard copy separates will be documented. Also, an analysis of both the results of this process and the methodology used to obtain them will be examined.

Editor's Note: The presenter may forward proceeding related materials before this talk is given. These materials were unavailable at the time of publication for these proceedings.

UTILIZING USGS 3-ARC-SECOND DEMS FOR GIS-ASSISTED RESOURCE MANAGEMENT PLANS

(LAND USE PLANNING)

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ABSTRACT

USGS Digital Elevation Models (DEMs) are digital records of terrain elevations for ground positions at regularly spaced horizontal intervals. Three-arc-second data are available in 1 x 1 degree (1:250,000 scale) maps, with a 3-arc-second ground distance between each pair of digitized points. They are produced from contour plates which have been digitized.

Currently, 3-arc-second DEMs are available throughout the entire continental U.S. and most of Alaska.

For several years, BLM State Offices have attempted to utilize USGS 3-arc-second DEM data for Resource Area/District-wide analysis only to discover that this process is very time consuming and that the MAPS Projection Command failed to reproject the USGS DEM from a Lat/Long projection with acceptable accuracy.

After recently completing a pilot project involving the Service Center's Remote Sensing section (SC-671C) and TGS, Inc. personnel, I now believe that these problems have been overcome.

The Remote Sensing section offered to attempt the process for the current RMP effort in Utah, Diamond Mountain R.A., utilizing their SUN Workstation/LAS and ERDAS software. The four necessary 3-arc-second (1:250,000 scale) DEM files were acquired and the data were imported, merged, projected and intersected to boundary specifications. They also used LAS and ERDAS to create Slope, Aspect, and Elevation Class maps and converted the merged DEM to feet, and converted all files to MAPS format in an extremely timely manner.

After careful verification in MAPS and COS I feel confident that this information is very accurate and has many potential applications for all resource programs across the Bureau.

Three-arc-second DEM information has four primary purposes for MOSS GIS projects:

1. Slope, Aspect and Elevation Analysis and Display
2. Administrative Unit Contour Lines
3. 3D Display
4. Administrative Unit VISTA Analysis

Keeping in mind that this information originates at a scale of 1:250,000 and is intended for Administrative-wide and not site specific applications, resource specialists should find it very useful, especially for Resource Management Plans. Many resources can be readily identified, correlated and predicted on the basis of given ranges of slope, aspect and elevation. When combined with other information such as soils or vegetation this analysis capability becomes even more powerful. In addition, VISTA analysis can readily be conducted on relatively large areas to determine all areas visible from a given road or road segment and the viewshed from a given point, like a scenic overlook. I'm certain that all resource programs should find applications if this information is available.

Contour line maps of any interval for entire administrative units can be prepared in MOSS. Contour lines can vastly improve GIS maps by identifying major geographical features, which can then be labelled.

It would be very difficult at best to conduct these types of administrative-wide unit functions with 7.5' DEMs, as there is not always 100% coverage and MOSS would not allow the merging of all files necessary to cover the project area.

3D display offers a unique way of visualizing and displaying the project area and resource information. Combining 3D display with the Drape and Display to Metafile functions in MAPS, the Cartographic Output System, and the merge capabilities of the Calcomp Color Electrostatic Plotter can result in a display that very effectively portrays terrain and resource locations in 3 dimensions. These maps can significantly improve the ability of reviewers to comprehend decisions.

SCANNING TECHNOLOGY: CONSIDERATIONS IN THE PREPARATION OF SCANNER READY MANUSCRIPTS

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ABSTRACT

With the increased availability of scanning technology, more organizations are recognizing it to be a "quick and easy" means of GIS data capture. However, the speed and accuracy of this approach is strongly tied to the quality of the source manuscripts. Not all manuscripts are scanner ready. This paper first examines the considerations necessary for the creation of scanner ready source maps. Secondly, it discusses criteria for evaluating the suitability of existing manuscripts for this type of capture.

Editor's Note: The presenter may forward proceeding related materials before this talk is given. These materials were unavailable at the time of publication for these proceedings.

BLM SERVICE CENTER SCANNING AND LTPLUS ACTIVITIES

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SESSION 4: GIS COMPUTATIONAL MODELING

WEDNESDAY, DECEMBER 11, 1:30 PM - 3:00 PM

SESSION CHAIRPERSONS:

Jack Sheffey and Patrick Madigan

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A COMBINED GIS-HEC PROCEDURE FOR FLOODPLAIN ANALYSES

S.G. McLin[1] and G.W. Fuller[2]

ABSTRACT

The Hydrologic Engineering Center's Flood-Hydrograph (HEC-1) and Water Surface Profile (HEC-2) models are routinely used to define floodplain elevations. Unfortunately HEC-2 simulations require stream channel and floodplain boundary geometries as input data. This information can be costly if extensive surveying is required. Detailed topographic data are commonly available from graphic information systems (GIS). These disjointed technologies can be combined if the GIS system has a drainage recognition capability. A conceptual procedure is suggested for incorporating this feature into the GIS framework so that cross-sectional information can be extracted and exported to HEC-2. A combined GIS-HEC application in ungaged watersheds at Los Alamos National Laboratory is described. This floodplain mapping procedure uses topographic data from the Laboratory's MOSS graphic information system. About 65% of the Laboratory has two foot topographic contour interval coverage, while 35% has ten foot coverage. Targeted stream channel segments are initially specified in the MOSS system, and topographic profiles along stream-channel cross-sections are extracted automatically. Each 2-D profile is stored as a 3-D MOSS line feature using New Mexico State Plane coordinates. This procedure is initiated at a convenient downstream location within each watershed, and proceeds upstream to a selected termination point. These 3-D line features are then exported in a format satisfying HEC-2 input data requirements.

HEC-2 utilizes the stream channel geometry extracted from MOSS and HEC-1 generated storm hydrographs from selected locations in the watershed to define the floodplain. The HEC-2 computed water surface elevation at each channel section, along with the left and right channel stations where this water surface intersects the ground, are read back into the MOSS system. These paired station locations are then converted to unique geographically referenced coordinates that define the 100-year flood-pool. Finally, adjacent coordinate pairs are linked together as MOSS area features to identify each watershed floodplain. In this particular application, 13 separate elongated watersheds traverse Laboratory lands, with individual channels ranging up to 11 miles in length. The 100-year floodplain was defined on each channel segment at 250 foot intervals, and detailed 1:4800 scale maps were generated.

KEY WORDS: GIS, HEC, FloodPlain Analyses

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INTRODUCTION

The Los Alamos National Laboratory was established in 1943 as a research and development facility committed to physical, biomedical, and environmental study. Although the Laboratory has maintained a comprehensive environmental monitoring program since 1949, it became a Resource Conservation and Recovery Act (RCRA) permitted facility in 1990. The U.S. Environmental Protection Agency (EPA) has stipulated that these waste treatment, storage, and disposal facilities must delineate all 100-year floodplain elevations within their boundaries. Floodplain mapping procedures must be equivalent to those used for the Federal Insurance Administration. Prior to this RCRA permit condition, floodplain boundary locations had never been systematically mapped within the Laboratory complex. This RCRA permit requirement was addressed by application of the computer based Flood Hydrograph Package (HEC-1) and the Water Surface Profiles Package (HEC-2), developed by the Hydrologic Engineering Center of the U.S. Army Corps of Engineers (COE, 1990 and 1982). These techniques are well documented and routinely used for floodplain analyses in ungaged watersheds (for example, see Viessman, et al., 1977; or Hoggan, 1989). Unfortunately, HEC-2 simulations require stream channel and floodplain boundary geometries as input data. This information can be costly if traditional field surveying is required. However detailed topographic information is commonly available in digital form. These distinctly separate technologies can be merged if the GIS system has a drainage recognition capability.

The floodplain mapping procedure outlined here used topographic data from the Laboratory's MOSS database. About 65% of the Laboratory has two foot topographic contour interval coverage, while 35% has 10 foot coverage. The Laboratory is located in north-central New Mexico about 60 miles north-northeast of Albuquerque, and 25 miles northwest of Santa Fe. Los Alamos has a semiarid, temperate mountain climate. This 43 square mile facility is situated on Pajarito Plateau between the Jemez Mountains on the west and the Rio Grande Valley to the east. The Plateau slopes toward the southeast for more than 15 miles, where it terminates along the Rio Grande at White Rock Canyon. Altitudes range from 7,800 feet above sea level along the western facility margin to about 6,200 feet at the canyon rim. The Plateau is dissected by a system of ungaged watersheds with ephemeral stream drainage. These watersheds are elongated in the east-west direction along Pajarito Plateau, and are extremely narrow in the north-south direction. All total, there are 13 separate watersheds draining Laboratory lands that contain over 100 channel miles requiring floodplain definition. These floodplains were defined at 250 foot intervals using MOSS topographic data. Obviously, this level of detailed mapping would have been cost prohibitive if conventional surveying techniques had been employed. These floodplain boundary maps will eventually provide a foundation for contaminated sediment transport simulations required under U.S. Department of Energy site performance assessment criteria.

GIS DATA EXTRACTION METHODOLOGY

Integrating graphic information system (GIS) databases with hydrologic models suggests many exciting possibilities. Recently automated techniques have been developed to extract important features from digital elevation models (Jensen, 1989). Some of these extracted features include watershed boundaries, drainage networks, and connectivity relationships. For the surface water hydrologist, perhaps one of the greatest needs is the ability to automatically extract stream channel cross-sectional geometries in digital form. This paper describes an application of floodplain modeling in complex terrain using MOSS extracted topographic data.

The successful marriage of modern GIS databases and hydrologic models is still an emerging technology. Most federal, and many State, facilities already have significant GIS topographic coverage. Hence the concepts presented here should be widely applicable. However, most GIS systems lack a drainage recognition capability. In other words, these systems lack the necessary software support that can uniquely and independently define a random gravity drainage pathway for a given topographic surface once a starting point has been specified. The MOSS system at the Laboratory is certainly no exception. Our solution to this problem was quite direct. We identified all major stream channels within the Laboratory complex on 7.5 minute USGS topographic maps. These channel locations were then digitized and entered into a MOSS file with the channel name as an attribute. These channel location files then became the system's drainage recognition mechanism. These targeted stream channel segments were segregated within MOSS into cross-section intervals so that topographic profiles could be automatically extracted. Each 2-D topographic profile was stored as a 3-D MOSS line feature using New Mexico State Plane coordinates. This procedure was initiated at the intersection of the eastern facility boundary and each watershed stream channel, and proceeded upstream to the western facility boundary. These 3-D line features were then exported from MOSS in an ASCII format satisfying HEC-2 input data requirements.

In order to transport MOSS topographic data to a HEC-2 input data file, a series of user activated steps is performed on existing and derived MOSS data sets. These existing data sets include topographic contour and stream channel location files. Derived data sets include extracted topographic profiles at stream cross-sections, and the imported maps produced from these profiles. Once a HEC-2 watershed simulation has been completed, then floodplain elevations and station coordinates are read back into MOSS. The HEC-2 output file name must correspond to the original MOSS data extraction output file, and the individual stream channel cross-sections in both files must be identically numbered. This scheme enables MOSS to geographically reference HEC-2 floodplain coordinates with known bench marks using a MOSS data reformatting program. Automated topographic data extraction, file generator and reformatting, and floodplain reinsertion programs were developed by the second author to complete these tasks. Documentation for these MOSS program procedures is listed in McLin (1991).

SIMULATION OF FLOODPLAIN BOUNDARIES

Actual floodplain hydrology simulations were performed on a PC-type microcomputer using HEC-1 and HEC-2, developed by the COE Hydrologic Engineering Center in Davis, California. These event simulation models are recognized by the EPA and others as state-of-the-art techniques for ungaged watersheds. HEC-1 simulates either real or hypothetical storm hydrographs at selected channel locations within each ungaged or gaged watershed in response to user specified rainfall hyetographs. This information, along with the stream channel geometry extracted from the MOSS system, was then utilized by HEC-2 to define each floodplain. This approach employed the 100-year, 6-hour design storm event for Los Alamos, and the familiar synthetic unit hydrograph technique. However, alternative floodplain elevations produced by different storm events may also be easily computed.

Figures 1 and 2 show the HEC-1 100-year and 2-year hydrograph peaks, respectively, for all channels crossing the downstream facility boundary. These figures also show corresponding hydrograph peaks produced from an empirical USGS technique (Waltemeyer, 1986) for comparison. The USGS approach consistently yields higher peak flows than HEC-1. The reason for these differences is centered on the storm pattern incorporated into each technique, and the fact that the HEC-1 model theoretically simulates the rainfall-runoff process more realistically.

HEC-2 calculates and plots water surface profiles for subcritical, critical, and supercritical gradually varied steady flows in channels using a standard step numerical method to solve the Bernoulli equation. Many channel segments may have mixed flow regimes, characterized by sub- and supercritical flows that occur simultaneously in different parts of a single cross-section, or in adjacent cross-sections. Here, separate HEC-2 simulations must be made for each flow condition to determine the complete water surface profile. The MOSS data extraction procedure described above will generate separate HEC-2 input data files to simulate these mixed flow regimes.

Traditionally, stream channel cross-sectional geometries have been the most restrictive input data requirement for HEC-2. This limitation may be overcome if a GIS database is available. There are numerous hydrologic modeling implications than can be explored once a GIS database has been accessed. For example, hydrologists have typically recommended that HEC-2 channel cross-sections be optimally located to reduce surveying costs. Generally these sections are placed anywhere from 1,000 to 10,000 feet apart, depending on tributary inflows and changes in channel slope. Access to GIS cross-sectional data removes this artificial constraint. Hence we were able to evaluate the influence of cross-sectional separation distance on predicted floodplain boundaries by making repeated HEC-2 simulations. Cross-sectional intervals were systematically varied between 250, 500, 1000 and 2000 feet, respectively. Figure 3 shows the HEC-2 predicted 100-year floodplain top width-to-depth ratio for the 250 and 2000 foot section simulations in Los Alamos Canyon, while Figure 4 shows the cumulative floodplain areas for each of these model configurations. These results suggest that closer cross-sectional spacing generally yields somewhat wider computed floodplain boundaries. Obviously there is a point of diminishing returns where hydrologic modeling assumptions and inaccuracies inherent to the rainfall-runoff process will overwhelm continued improvements in channel geometry definition. At Los Alamos, a separation distance between 250 and 500 feet seems adequate for this particular application.

Without GIS extracted topographic profiles, a detailed hydraulic characterization of the channel is not practical. For example, Figure 5 shows unit stream power associated with the 100-year hydrograph peak along Los Alamos Canyon as a function of the energy slope/Froude number ratio. When correlated with particle grain size distributions, this information may suggest important sediment transport relationships. A second example is shown in Figure 6, which depicts mean channel water velocity along Los Alamos Canyon.

CONCLUSIONS

The Laboratory's MOSS graphic information system was used in this study to define all topographic profiles for HEC-2 stream channel cross-sections at 250 foot intervals. These data were automatically extracted from the MOSS system in an ASCII format compatible with HEC-2 input data requirements. Approximately 65% of the facility has two foot topographic contour data, and 35% has 10 foot data. Once the floodplain boundaries had been defined for all major watershed channels using the HEC-2 model, then this information was read back into the MOSS system and detailed maps were generated. This procedure is recognized as a state-of-the-art technique in ungaged watersheds, and fully satisfies the RCRA permit condition requiring floodplain definition.

One might question the influence of refined topographic contour intervals on the predicted floodplain boundary. The Laboratory is currently completing a new aerial photographic survey that will provide two-foot topographic contour coverage for the entire facility. Hence comparisons of floodplain simulations using two, 10, or 20 foot topographic contour interval data will be possible. These efforts may suggest a methodology to characterize errors in floodplain boundary locations resulting from profiles constructed with different topographic contour data sets.

Finally it should be noted that criticism of the rainfall-runoff event simulation approach used by HEC-1 centers on the design assumption that rainfall of a given frequency results in runoff of the same frequency. Continuous rainfall-runoff simulation models calibrated to specific gaged watersheds may represent an improvement over the HEC-1 and HEC-2 modeling procedures employed in this study. However extension of these research models to ungaged watersheds has not been adequately documented in the literature. Until the dynamic nature of the rainfall-runoff process is better understood, HEC-1 and HEC-2 will continue to represent the best available technology for floodplain definition in ungaged watersheds. Combining these models with GIS data certainly represents an advancement in their continued use.

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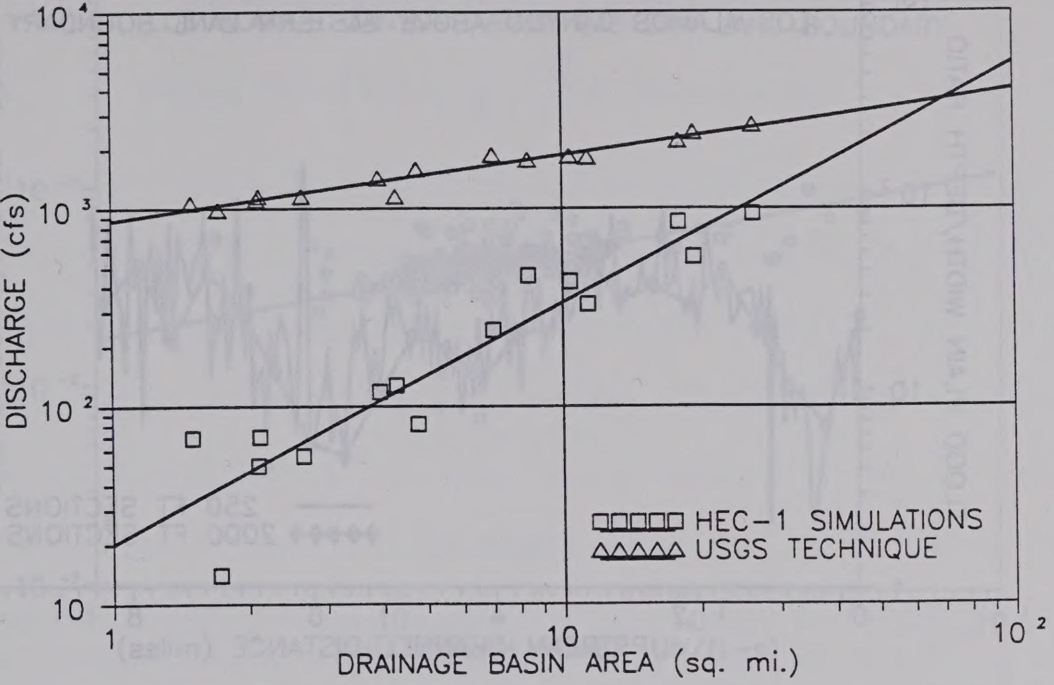

Fig. 1. Drainage basin area versus 100-year peak discharge at the eastern facility boundary.

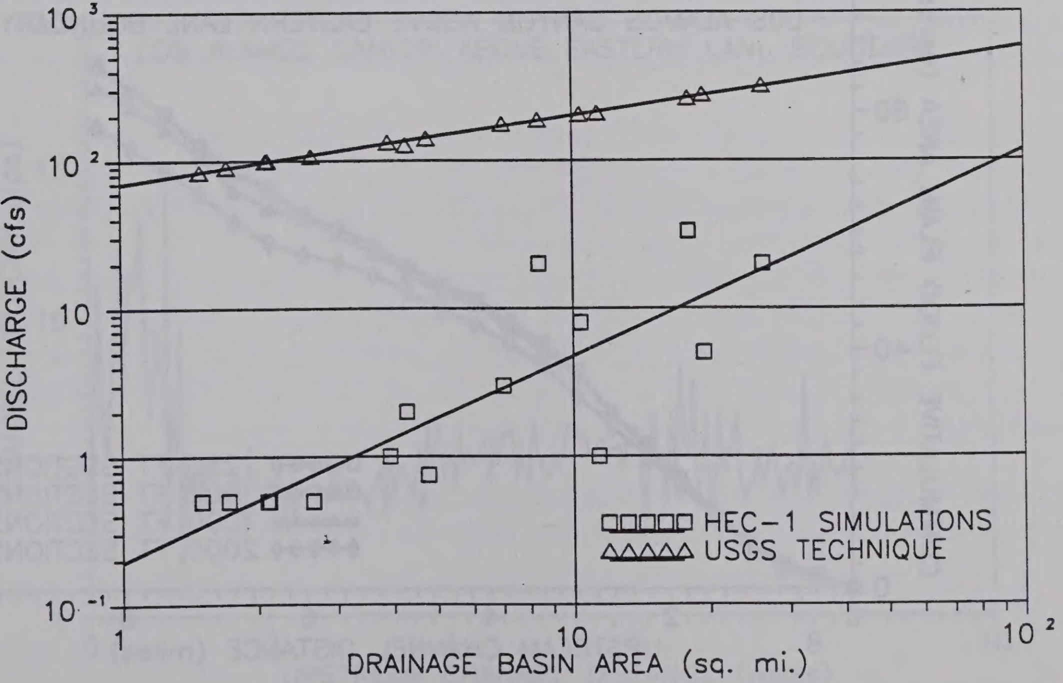

Fig. 2. Drainage basin area versus 2-year peak discharge at the eastern facility boundary.

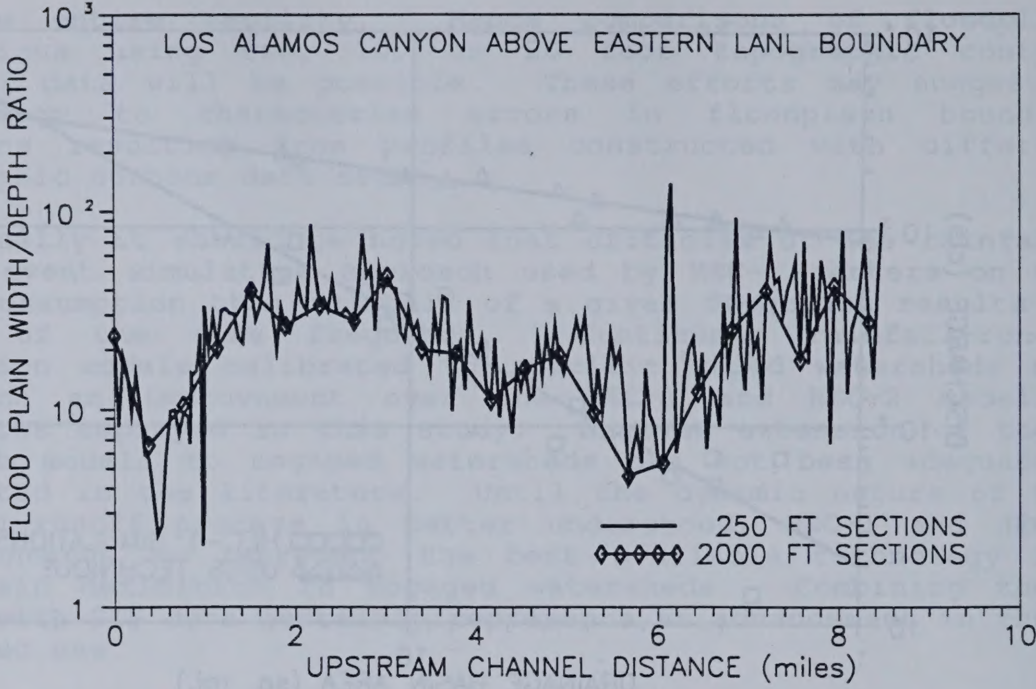

Fig. 3. Floodplain width-to-depth ratio for Los Alamos Canyon.

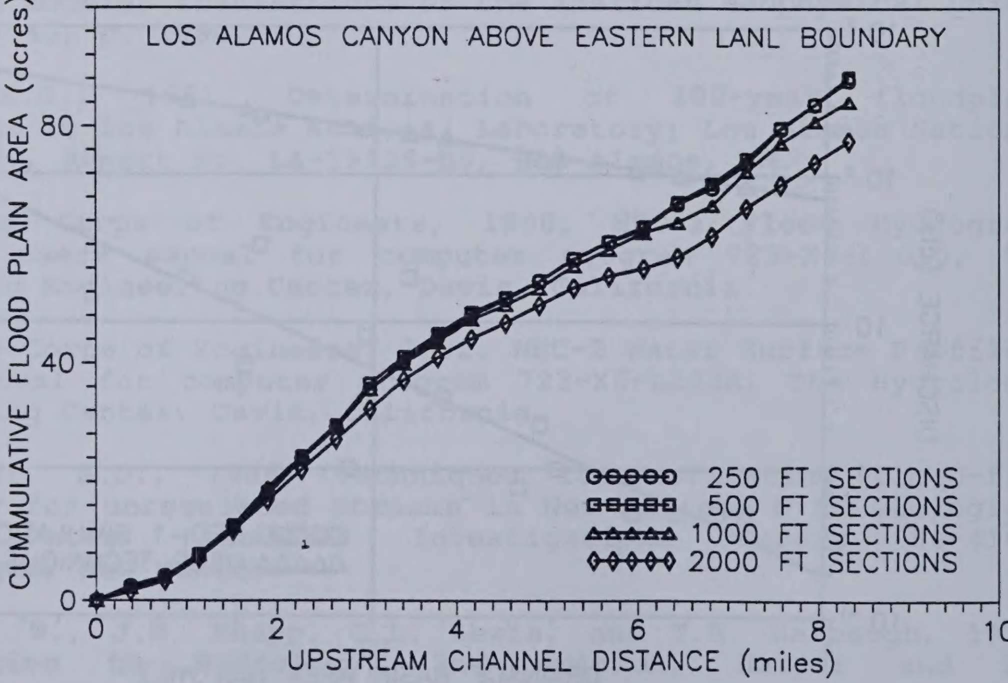

Fig. 4. Cumulative floodplain area in Los Alamos Canyon.

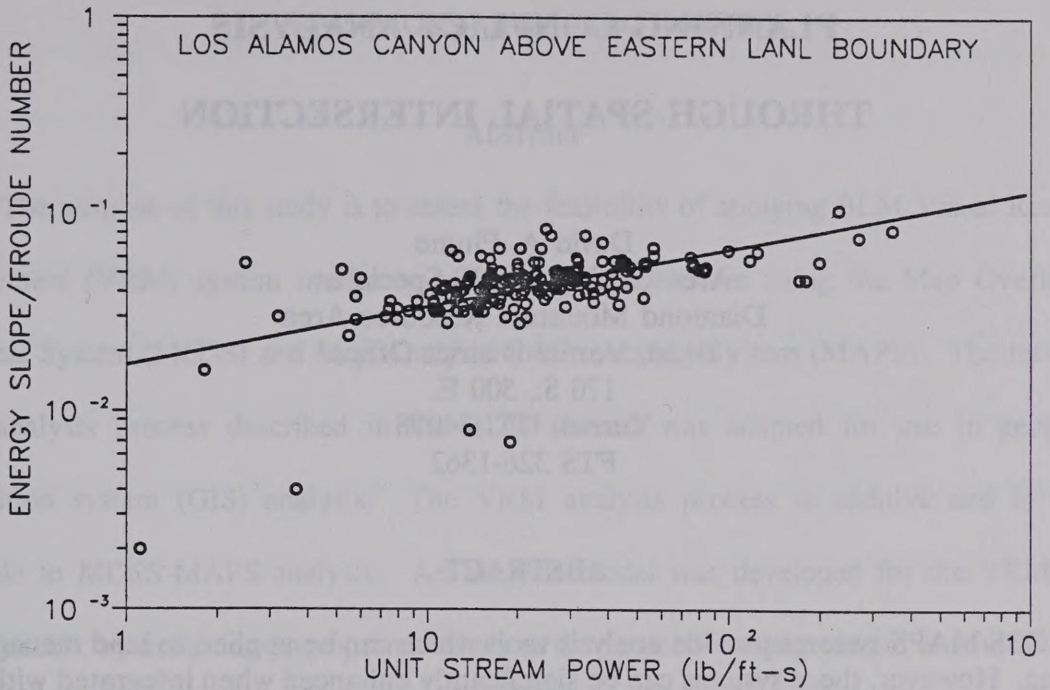

Fig. 5. Energy slope/Froude number ratio as a function of unit stream power for Los Alamos Canyon.

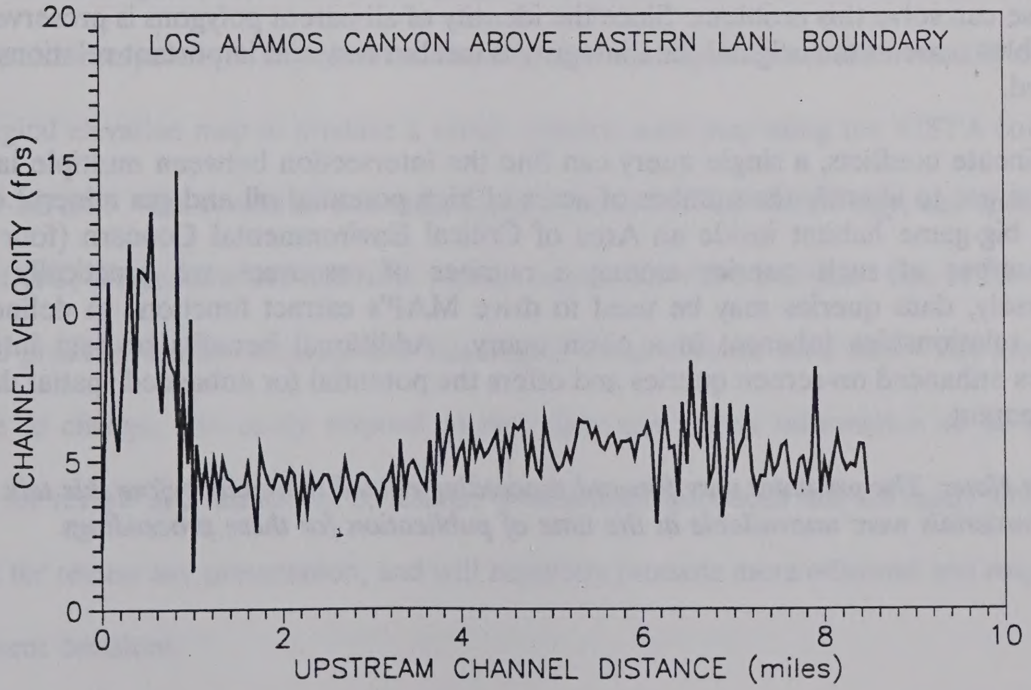

Fig. 6. Predicted channel water velocity during a 100-year flood in Los Alamos Canyon.

PLANNING CONFLICT ANALYSIS

THROUGH SPATIAL INTERSECTION

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ABSTRACT

The MOSS/MAPS systems provide analysis tools which can be applied to land management planning. However, these systems can be significantly enhanced when integrated with a text oriented data base management system.

Significant conflicts are inherent in multiple use planning and must be identified and quantified in a plan. Raster intersection of resource data layers can establish relationships between resources. This reveals regions of potential conflict but complex relationships established in this way can't be quantified in any practical and efficient way in MOSS/MAPS. Nonetheless, transfer of data tables representing all intersected data polygons to a relational database can solve this problem. Since the identity of all parent polygons is preserved in the data tables none of the original data integrity is lost but new and important relationships are revealed.

To delineate conflicts, a single query can find the intersection between multiple layers. It could be use to identify the number of acres of high potential oil and gas mineral estate in critical big-game habitat inside an Area of Critical Environmental Concern (four layers). The number of such queries among a number of resources are practically limited. Conversely, data queries may be used to drive MAP's extract functions to delineate the spatial relationships inherent in a given query. Additional benefits of data integration includes enhanced on-screen queries and offers the potential for enhanced spatial data base management.

Editor's Note: The presenter may forward proceeding related materials before this talk is given. These materials were unavailable at the time of publication for these proceedings.

VRMS/MOSS-MAPS PILOT STUDY

Abstract

The purpose of this study is to assess the feasibility of applying BLM Visual Resources Management (VRM) system inventory and analysis procedures using the Map Overlay and Statistical System (MOSS) and Map Analysis and Processing System (MAPS). The traditional VRM analysis process described in the BLM manual was adapted for use in geographic information system (GIS) analysis. The VRM analysis process is additive and is readily adaptable to MOSS-MAPS analysis. An analysis model was developed for the VRM rating system matrix by assigning appropriate values to the respective categories in each of the three VRM analysis components: scenic quality rating units, sensitivity level rating units, and visual distance zones. These components were then input as cell values and processed in MOSS-MAPS to produce the final VRM Inventory Class Map. Results of incorporating a MOSS-MAPS generated distance zone map into the analysis process in lieu of the field drawn distance zone map were also compared. A key observation point map was digitized and electronically overlaid on the digital elevation map to produce a visual distance zone map using the VISTA command in MOSS-MAPS. The results of this study suggest the use of GIS technology, and specifically MOSS-MAPS, is a feasible and desirable method to conduct VRM analysis. Use of the VISTA command produces a more accurate and meaningful visual distance zone map. The process is adaptable to change, can easily respond to new data and allows information to be quickly recycled for review and refinement of results. Products are produced that are easily stored and retrieved for review and presentation, and will hopefully promote more informed and responsive management decisions.

I. INTRODUCTION

The purpose of this study is to test the feasibility of applying BLM Visual Resources Management (VRM) system inventory and analysis procedures using the Map Overlay and Statistical System and Map Analysis and Processing System (MOSS-MAPS) geographic information system (GIS). The Cedar City District is in the process of writing two Resource Management Plans (RMP) for three resource areas. The plans will define management objectives for an area encompassing some 3.1 million acres. Typically, the District is faced with limited resources, a fairly short time frame, and an expanding workload while completing these RMP's. The visual resource inventory is an extremely important component of the RMP for this very scenic southern Utah landscape and is expected to be intensely scrutinized by the public throughout the planning process. Approximately 2.5 million acres of the planning area require a visual resource inventory. Since GIS will play an integral part in the planning process and in response to the availability of limited resources to complete the VRM inventory, the decision was made to attempt to automate the traditional VRM inventory and analysis process and thereby utilize available resources to complete the project.

An eight 7.5-minute quad study area east of Kanab, Utah was selected and inventoried following BLM Manual procedures. The data was digitized into the Utah State GIS with the Automated Digitizing System (ADS) and analyzed using MOSS-MAPS software. A distance zone map was also generated within MOSS, utilized for analysis, and compared with analysis results using the field drawn distance zone map.

II. THE VISUAL RESOURCE MANAGEMENT INVENTORY & ANALYSIS PROCESS

The visual resource inventory process is used by BLM managers to assess visual values of the public lands. The inventory consists of three components: a scenic quality evaluation, a sensitivity level analysis, and a delineation of visual distance zones. Scenic quality is a measure of the visual appeal of a tract of land. Seven key factors are ranked on a comparative basis with similar features within the physiographic province to determine the apparent scenic quality of the landscape. These factors are: landform, vegetation, water, color, adjacent scenery, scarcity, and cultural modifications. As a result of a scoring process, the public lands are assigned an "A", "B", or "C" scenic quality rating. Sensitivity level analysis is conducted to determine levels of public concern for scenic quality. Indicators of public concern are evaluated for each sensitivity level rating unit. The sensitivity level rating units are then assigned a high, moderate, or low rating based on this analysis. The indicators evaluated are: type of users, amount of use, public interest, adjacent land uses, and special areas. Visual distance zones are based on the relative visibility of the landscape from selected observation points or travel routes. Three distance zones are generally delineated: foreground-middleground, background, and seldom-seen. Foreground-middleground (f/m) is that area visible to a distance of 3 to 5 miles. Background is the visible area beyond the foreground-middleground zone up to a distance of 15 miles. Areas that are hidden from view are in the seldom-seen (ss) zone.

Three mylar overlays are prepared with each layer of spatial information for use in the analysis process to determine the visual resource inventory classes for the public lands. The analysis process consists of overlaying mylar overlays for each theme and drafting the visual resource inventory classes on a fourth sheet of mylar. The following table is adapted from Section H-8410-1 of the BLM manual and illustrates how the inventory classes are determined.

Table 1. **Visual Resource Inventory Class Matrix.**

	VISUAL SENSITIVITY LEVELS						
	High			Moderate			Low
SPECIAL	I	I	I	I	I	I	I
SCENIC A	II	II	II	II	II	II	II
QUALITY B	II	III	III	III	IV	IV	IV
C	III	IV	IV	IV	IV	IV	IV
	f/m	b	ss	f/m	b	ss	ss
	VISUAL DISTANCE ZONES						

The inventory classes represent the relative value of the visual resources. Classes I and II represent the highest value, Class III is a moderate value, and Class IV has the lowest value. The visual resource inventory classes are the basis for considering visual values during the RMP process. It is through the RMP process that visual resource management classes are established and visual resource management objectives are defined for each class. Figure 1 illustrates the traditional VRM inventory and analysis process.

III. TRADITIONAL VRM ANALYSIS METHODS APPLIED WITH GIS TECHNOLOGY

This study process consisted of the following five phases: Pre-Inventory, Inventory, Data Input, and Data Analysis and Results. This is a recommended logical process to follow when conducting a VRM inventory.

A. Pre-Inventory

This phase of the study process consists of an orientation period to become familiar with the study area and the computer hardware and software. Personnel performing the VRM inventory should undertake any necessary training to hone their inventory skills and to become familiar with the computer analysis process. In this case, quad maps were compiled into one study area map, and major roads, recreation areas, campgrounds, perennial rivers and streams,

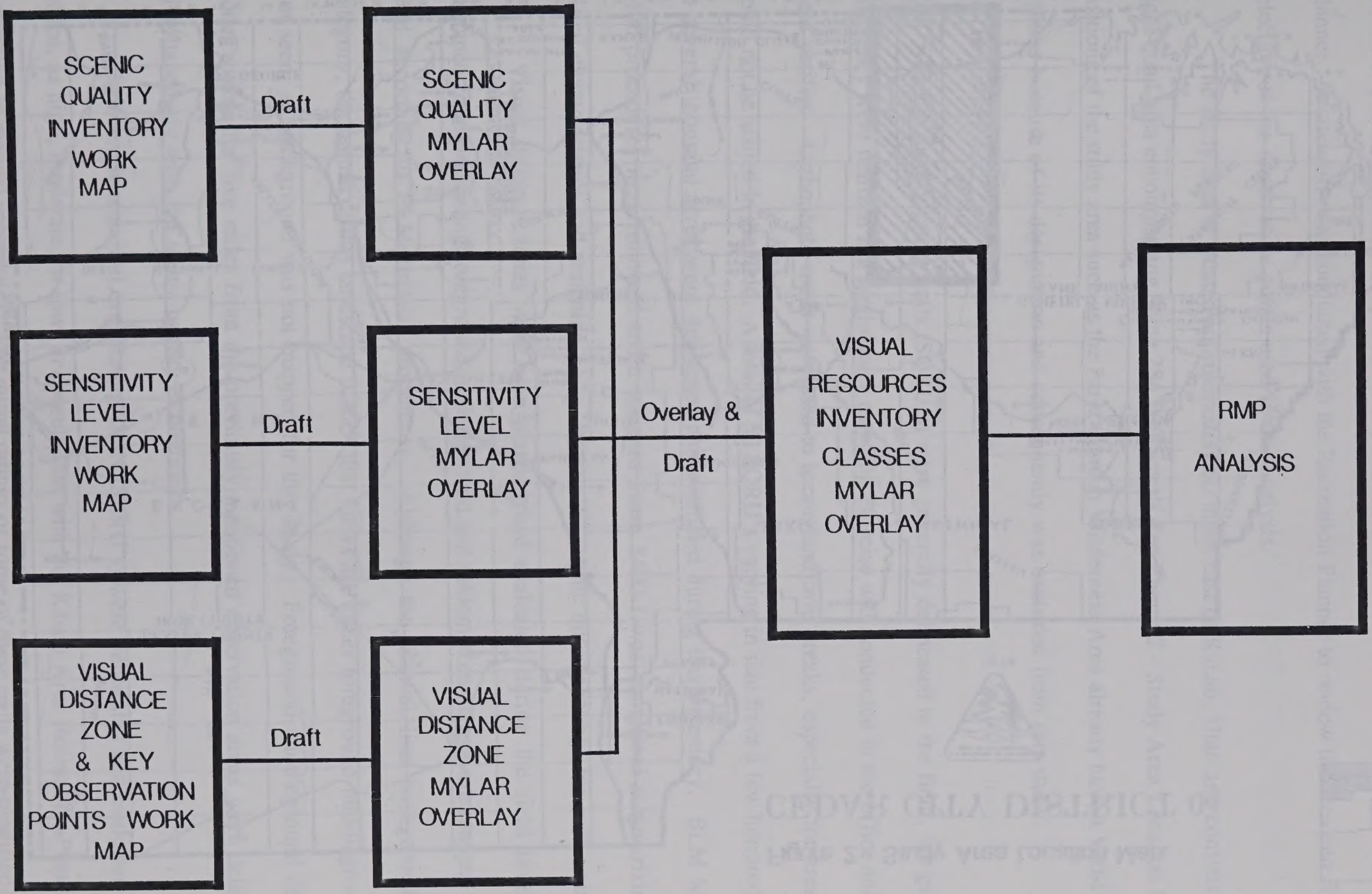
SCENIC QUALITY INVENTORY WORK MAP
Draft
SCENIC QUALITY MYLAR OVERLAY
SENSITIVITY LEVEL INVENTORY WORK MAP
Draft
SENSITIVITY LEVEL MYLAR OVERLAY
VISUAL DISTANCE ZONE & KEY OBSERVATION POINTS WORK MAP
Draft
VISUAL DISTANCE ZONE MYLAR OVERLAY
Overlay & Draft
VISUAL RESOURCES INVENTORY CLASSES MYLAR OVERLAY
RMP ANALYSIS

Figure 1. Traditional VRM Inventory & Analysis Process

Figure 2 - Study Area Location Map.

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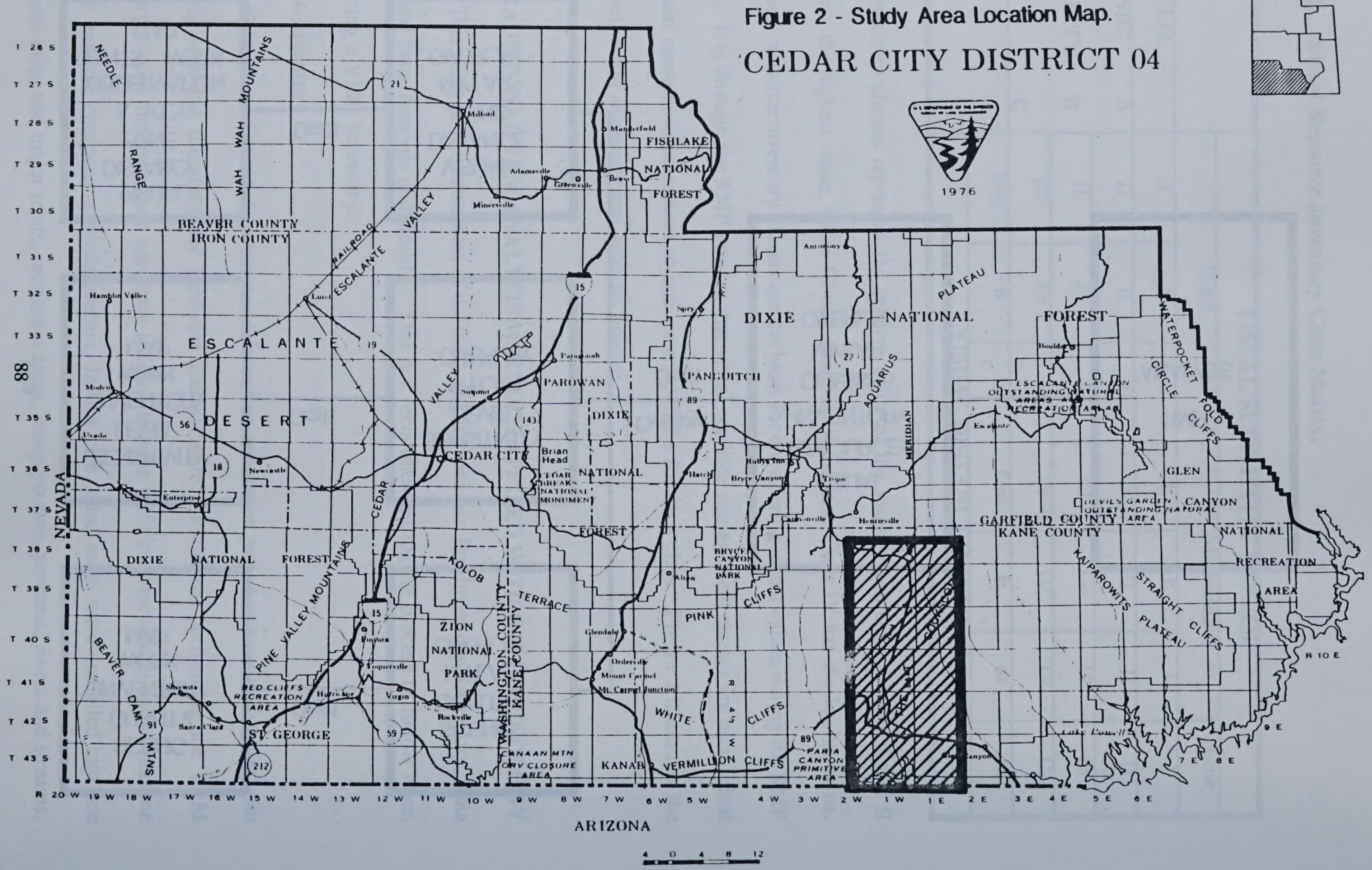
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IRON COUNTY
ESCALANTE VALLEY
RAILROAD
15
Hamblin Valley
Lund
ESCALANTE
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PAROWAN
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DIXIE
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TERRACE
ZION NATIONAL PARK
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Toquerville
BEAVER DAM MTNS
Shivwits
RED CLIFFS RECREATION AREA
Hurricane
Virgin
Rockville
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Santa Clara
ST. GEORGE
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WASHINGTON COUNTY
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Escalante
WATERPOCKET FOLD
CIRCLE CLIFFS
Rubys Inn
Bryce Canyon
Tropic
Hatch
Cannonville
Henrieville
GLEN
DEVILS GARDEN OUTSTANDING NATURAL AREA
CANYON
GARFIELD COUNTY
KANE COUNTY
NATIONAL
RECREATION
AREA
BRYCE CANYON NATIONAL PARK
Alton
PINK CLIFFS
KAIPAROWITS PLATEAU
STRAIGHT CLIFFS
Glendale
Orderville
Mount Carmel
Mt. Carmel Junction
WHITE CLIFFS
89
PARIA CANYON PRIMITIVE AREA
KANAB
VERMILLION CLIFFS
Big Canyon
Lake Powell
R 10 E
9 E
7 E
8 E
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and other potential observation points were plotted for review with the Kanab Area Recreation Planner. A site visit was conducted with the Recreation Planner to review the area and finalize selection of the observation points used in this analysis.

The study area is located approximately 30 miles east of Kanab, Utah and consists of an eight quad area encompassing some 284,000 acres (See Figure 2 - Study Area Location Map). Portions of the study area such as the Paria Canyon Wilderness Area already have a VRM Class I status because of its designation and consequently was excluded from this study.

B. Inventory

Scenic quality rating units (SQRU's) were generally delineated in the field, but gains in efficiency were realized if a preliminary mapping exercise was conducted in the office and then field verified. Orthophoto maps were used to locate landform breaks, especially for areas that could not be visited in the field. A total of 50 SQRU's varying in size from a few hundred acres to several thousand acres were delineated and evaluated during this inventory. BLM Manual 8400 procedures were followed and a standard Form 8400-1 was completed summarizing the visual characteristics and assigning "A", "B", or "C" scenic quality ratings for each unit.

Visual distance zones were also mapped and evaluated during the field inventory. Distance zones indicating foreground-middleground and seldom-seen areas were mapped in the field according to BLM manual procedures. Although the manual lists background as a category, the nature of this landscape is such that views are either foreground-middleground or not seen, so background was not mapped for this study. Foreground-middleground distance zones visible for five miles from the previously mentioned observation areas were delineated simultaneously with the scenic quality evaluation.

Eighteen Sensitivity Level Rating Units (SLRU's) were delineated and evaluated in the office, as high, moderate, or low, in consultation with the Kanab Area Recreation Planner and according to manual procedures. The initial ratings of some of these units were modified during the analysis process in consultation with the Cedar City District Recreation Planner.

Data collected during the inventory phase was reviewed and modified in consultation with the Kanab Area and Cedar City District Recreation Planners. A review process was also conducted following data input to the Utah State BLM GIS. Refinements included revising scenic quality ratings of some SQRU's, and spatially dividing and revising the ratings of some SLRU's.

C. Data Input & Analysis

All data collected during the Inventory Phase was digitized into the Utah State BLM GIS utilizing the Automated Digitizing System (ADS) software. The following themes were digitized:

-Scenic Quality Rating Units

-Visual Distance Zones

-Sensitivity Level Rating Units

Following digitization of the themes, the ADS files were converted to MOSS vector maps at the Utah State BLM office. These vector maps were then converted to raster format, assigned cell values, and electronically overlaid to generate the final Visual Resource Inventory Classes Map.

The first step in this process is to merge the quads maps into one map. This merged map establishes the "window" to be used for the rest of the analysis. The outline shown below illustrates a specific sequence of steps required to analyze each of the three VRM themes and to generate the final analysis map.:

1. Conduct field inventory and record spatial information on mylar overlays at an appropriate scale.
2. Digitize data using ADS to create a line or polygon map and assign attributes.
3. Convert the ADS data maps to MOSS vector maps.
4. Review accuracy of attributes for each polygon in the vector maps.

5. MERGE the 8 quad maps and set the window.

6. RASTERIZE each vector map to a discrete map with 150 meter X 150 meter cells. This cell size is approximately equal to 5.6 acres and was selected because it represents a reasonable cell size to use for analysis and it is compatible with the raster format of DEM data. It should be noted that if any analysis will involve DEM maps the cell sizes of all themes must be the same and the cell sizes must be described in metric units. Therefore, the analysis process should be well thought out prior to rasterizing any maps.

7. Label the cell values of each polygon by subject for each rasterized theme.

8. After executing the above sequence for each of the themes, ADD the three themes to create a new dichotomous map.

9. EXTRACT the new dichotomous map for a new discrete map, assigning new cell values to old cell values and/or a range of old cell values.

10. This extracted discrete map is the Visual Resources Inventory Classes Map and may be displayed on the terminal in color or shaded, or may be plotted.

Assignment of Cell Values - Since the conceptual MOSS/MAPS analysis process is basically the same as that outlined in the BLM VRM Manual, i.e. an additive overlay process, the process outlined above from Illustration 11 of Section H-8410-1 of the BLM Manual was adopted. Due to the nature of this landscape, the visual distance zones were either in the foreground-middleground or seldom-seen. For the purposes of this study, the background category was considered to equal the seldom-seen category.

Cell values for each category within the theme were calculated to replicate the results produced by the hand drawn overlay process. Values for each category within the respective themes were assigned as follows:

Scenic Quality: A = 6 B = 2 C = 1

Sensitivity Levels: High = 3 Moderate = 2 Low = 1

Distance Zones: f/m = 2 ss = 1

When these rasterized polygons are electronically overlaid and added, a range of cell values is produced in the form of a dichotomous map. In order to produce a discrete map that can be displayed in a meaningful manner, ranges of cell values are defined and extracted for new cell values. This extracted map is the Visual Resources Inventory Classes map. The cell value ranges and the reassigned values are listed below:

	Cell Value Range	Extracted Cell Value
Class II	7-11	2
Class III	6	3
Class IV	3-5	4

For example, let's assume a polygon has a scenic quality rating of "A" (6), a moderate sensitivity (2), and is in the foreground-middleground (2). Adding these cell values equals a sum of 10, classifying that polygon as Visual Resource Inventory Class II.

When possible, polygon boundaries of the various themes should be constructed to be coincident. This procedure will create a final map with simple polygons. This allows RMP decision-makers to assign visual resource management class objectives to landscape units which are more easily administered and more clearly understood by the public than a map with very complex and irregular polygons. The following matrix illustrates the BLM VRM rating system as adapted for GIS analysis and lists the GIS point totals (in parentheses) required for each classification.

Table 2. Visual Resource Inventory Class Matrix Adapted for GIS Analysis.

	VISUAL SENSITIVITY LEVELS						
	High (3)			Moderate (2)			Low (1)
SPECIAL	I	I	I	I	I	I	I
SCENIC A	II (11)	II (10)	II (10)	II (10)	II (9)	II (9)	II (8)
(6)	II (7)	III (6)	III (6)	III (6)	IV (5)	IV	IV (4)
QUALITY B	III (6)	IV (5)	IV (5)	IV (5)	IV (4)	IV	IV (3)
(2)	f/m (2)	b* (1)	ss (1)	f/m (2)	b* (1)	ss (1)	ss (1)
	VISUAL DISTANCE ZONES						

C (1)

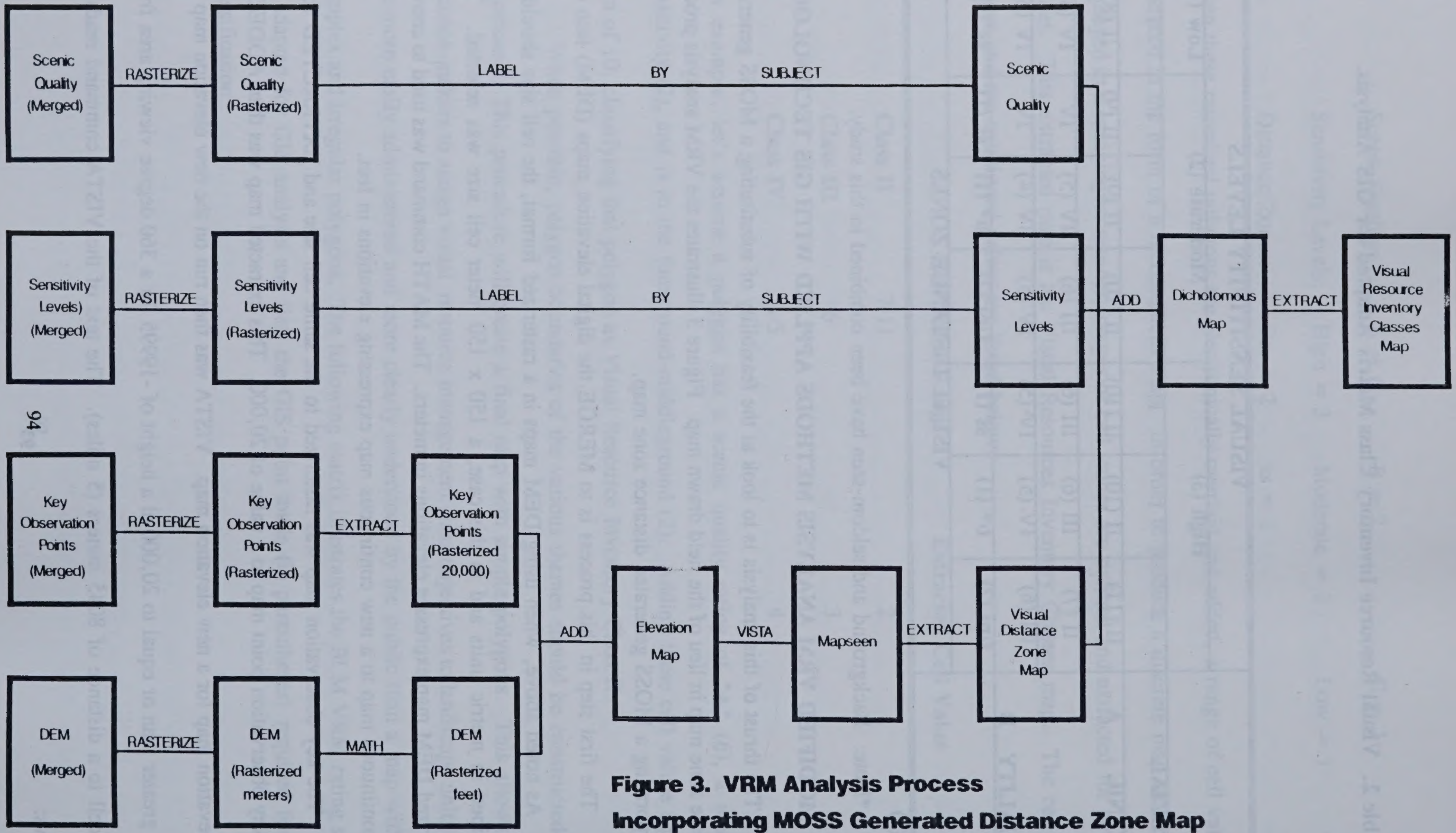
*Note: Background and seldom-seen have been combined in this study.

IV. MODIFIED VRM ANALYSIS METHODS APPLIED WITH GIS TECHNOLOGY

The thrust of this analysis is to look at the feasibility of substituting a MOSS generated distance zone map in lieu of the field drawn map. Figure 3 illustrates the VRM analysis process incorporating a MOSS generated distance zone map.

The first step in this process is to MERGE the digital elevation maps (DEM) into one map. As noted above, when using DEM maps in a rasterized format, the cell size should be described in metric units and in this case, a 150 x 150 meter cell size was selected. The rasterized DEM map expresses elevations in meters. The MATH command was used to convert this continuous map to a new continuous map expressing elevations in feet.

The key observation map was rasterized to the same cell size and EXTRACTED for a new key observation point map to a value of 20,000. This extracted map was then ADDED to the elevation map for a new elevation map. VISTA was then run on the new elevation map for Cells greater than or equal to 20,000 at a height of -19995 for a 360 degree viewing area from each cell to a distance of 8045 meters (5 miles). The text of the VISTA command reads as follows:


Scenic Quality (Merged)
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LABEL
BY
SUBJECT
Sensitivity Levels
ADD
Dichotomous Map
EXTRACT
Visual Resource Inventory Classes Map
Key Observation Points (Merged)
RASTERIZE
Key Observation Points (Rasterized)
EXTRACT
Key Observation Points (Rasterized 20,000)
ADD
Elevation Map
VISTA
Mapseen
EXTRACT
Visual Distance Zone Map
DEM (Merged)
RASTERIZE
DEM (Rasterized meters)
MATH
DEM (Rasterized feet)

Figure 3. VRM Analysis Process Incorporating MOSS Generated Distance Zone Map

VISTA NEWELEVATIONMAP FOR MAPSEEN FROM 20,000 THROUGH ,
26,575 HEIGHT -19995 SECTOR TO 8045

Mapseen is a continuous map with values from 1 to 26,575 illustrating the visible cells. Unseen cells have values of zero. Mapseen is then EXTRACTED to reassign cell values. The cell value range of 1 through 26,575 is reassigned a value of 2 and the cell value of zero is reassigned a value of 1. This new mapseen is then ADDED to the scenic quality and sensitivity level themes in the same manner as described above, to produce the Visual Resources Inventory Classes Map.

The MOSS generated distance zone map shows a larger visible area within five miles of the observation points than the field drawn map. Isolated visible areas were also more accurately identified than could be accomplished in the field. The field drawn distance zone map identified 112,726 acres as visible (See Figure 4), while the MOSS generated map showed 144,090 acres as visible (See Figure 5). These differences in visible areas affect each alternative of the Visual Resources Inventory Classes Map. The Visual Resources Inventory Map - Alternative 1 utilizes the Field Drawn Distance Zone Map in the analysis (See Figure 6). The Visual Resources Inventory Map - Alternative 2 utilizes the Computer Generated Distance Zone Map in the analysis (See Figure 7). A quantity comparison of acreages for each category in Alternative 1 and Alternative 2 is listed below:

	ALTERNATIVE 1	**ALTERNATIVE 2**
Class II	125,342 acres	127,610 acres
Class III	40,203 acres	46,269 acres
Class IV	118,681 acres	110,347 acres

As shown above, when the computer generated distance zone map is used in the analysis, the acreages in Alternative 2 for Classes II and III are increased, while the acreage in Class IV are decreased. Because of the increased accuracy of the Visual Distance Zone Map in Alternative

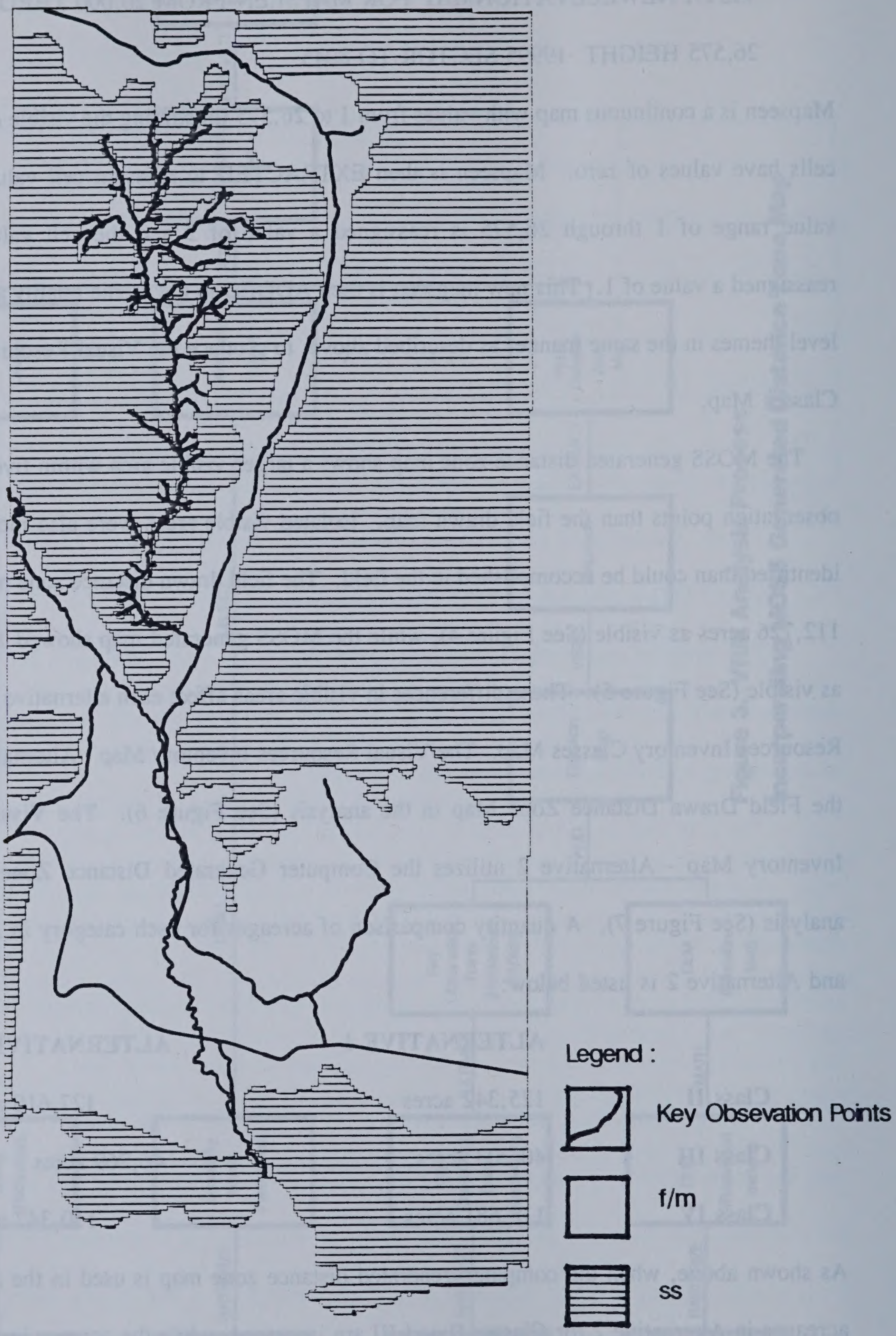

Legend :
Key Obsevation Points
f/m
ss

Figure 4. Field Drawn Distance Zone Map.

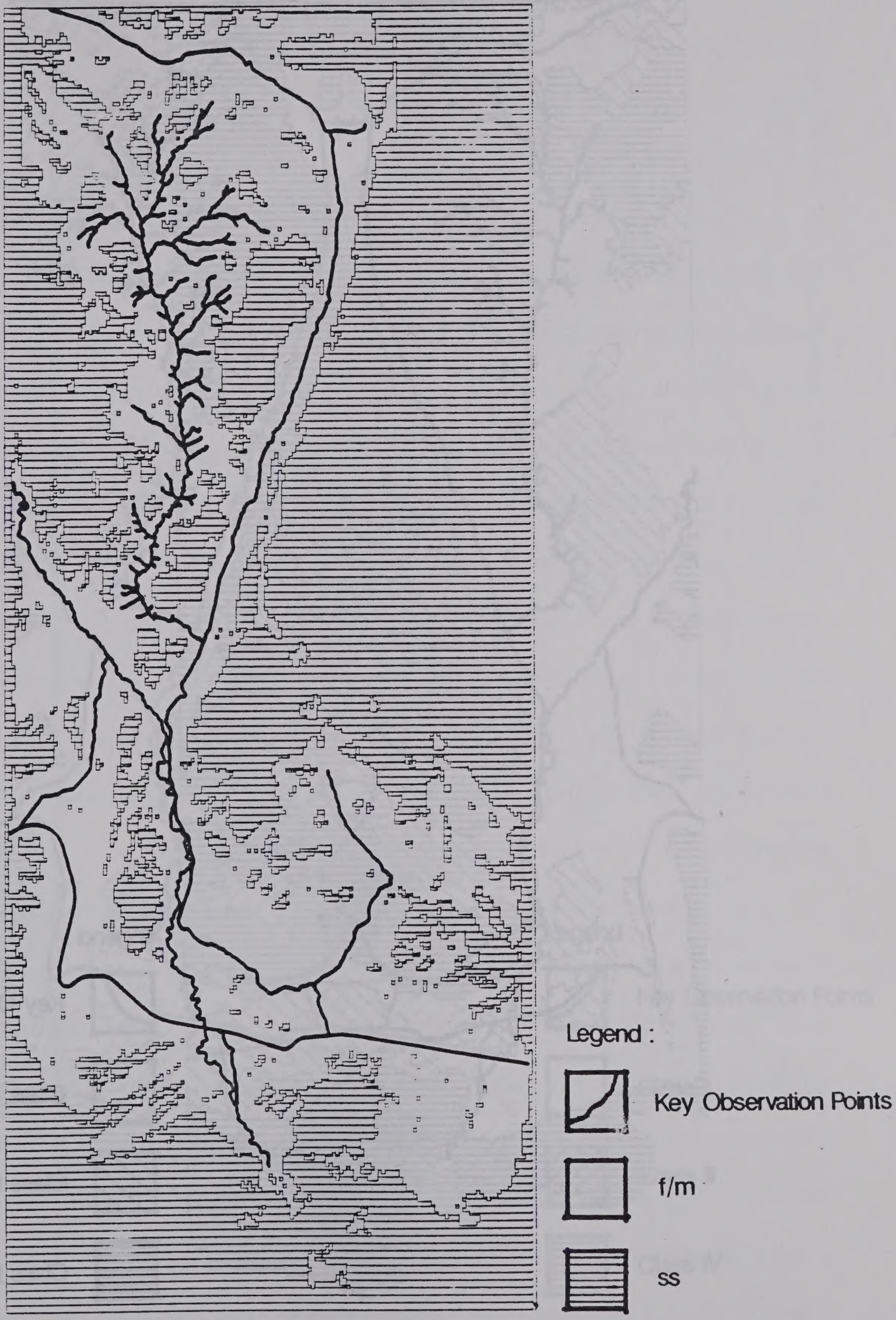

Legend :
Key Observation Points
f/m
ss

Figure 5. MOSS Generated Distance Zone Map.

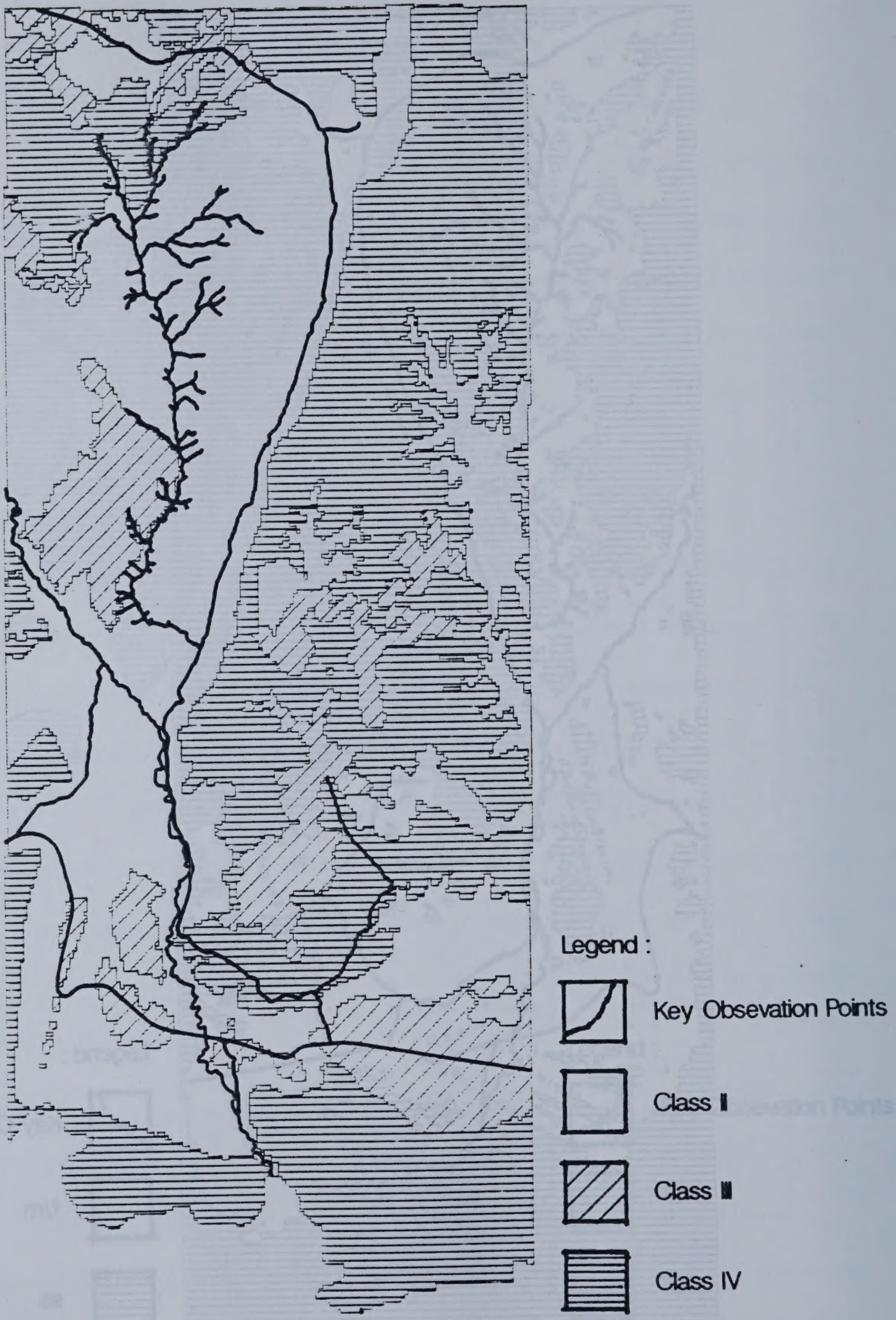

Legend :
Key Obsevation Points
Class II
Class III
Class IV

Figure 6. Visual Resources Inventory Classes Map (Alternative 1).

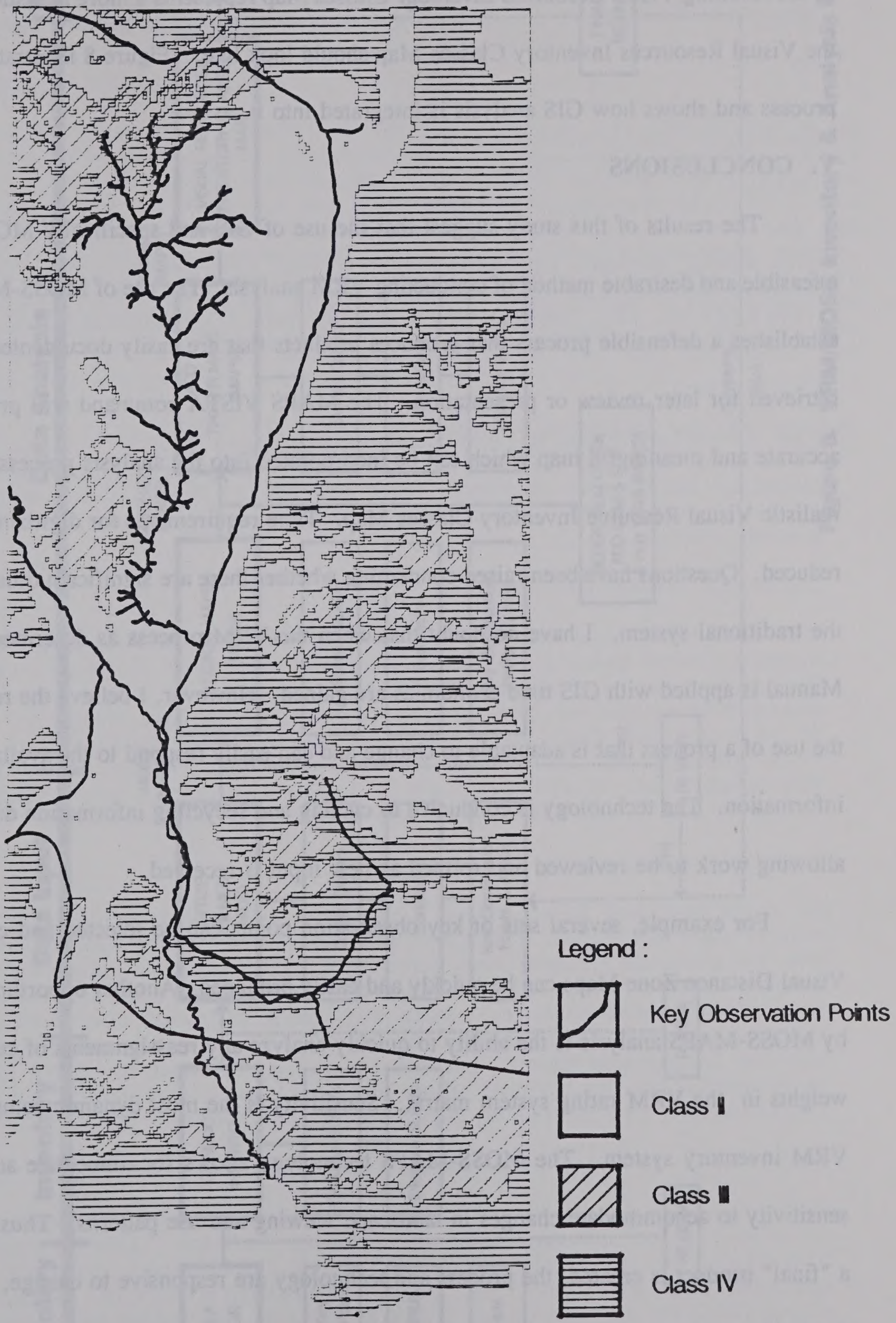

Legend :
Key Observation Points
Class II
Class III
Class IV

Figure 7. Visual Resources Inventory Classes Map (Alternative 2).

2, the resulting Visual Resources Inventory Classes Map represents a more realistic view of what the Visual Resources Inventory Classes Map should look like. Figure 8 illustrates this overall process and shows how GIS analysis is integrated into it.

V. CONCLUSIONS

The results of this study suggest that the use of GIS and specifically MOSS-MAPS, is a feasible and desirable method of conducting VRM analysis. The use of MOSS-MAPS analysis establishes a defensible process that produces products that are easily documented, stored, and retrieved for later review or presentation. The MAPS VISTA command will produce a more accurate and meaningful map which can be incorporated into the analysis process to generate a realistic Visual Resource Inventory Classes Map. Time requirements for digitizing will also be reduced. Questions have been raised concerning whether there are significant time savings over the traditional system. I have no doubt that when the VRM process as described in the BLM Manual is applied with GIS time economies are gained. However, I believe the real value is in the use of a process that is adaptable to change and can easily respond to the availability of new information. The technology is conducive to cycling and recycling information during analysis allowing work to be reviewed and refined as new input is received.

For example, several sets of key observation points can be selected and corresponding Visual Distance Zone Maps can be quickly and easily produced. Another opportunity presented by MOSS-MAPS analysis is the ability to quickly analyze any reassignments of cell values and weights in the VRM rating system matrix. Sensitivity is the most dynamic component of the VRM inventory system. The MOSS-MAPS technology allows for immediate adjustments of sensitivity to accommodate changes in landscape viewing and use patterns. Thus even though a "final" product is created, the process and technology are responsive to change, and are able to quickly and easily incorporate new data into analysis, show its effects, and hopefully promote informed management decisions.

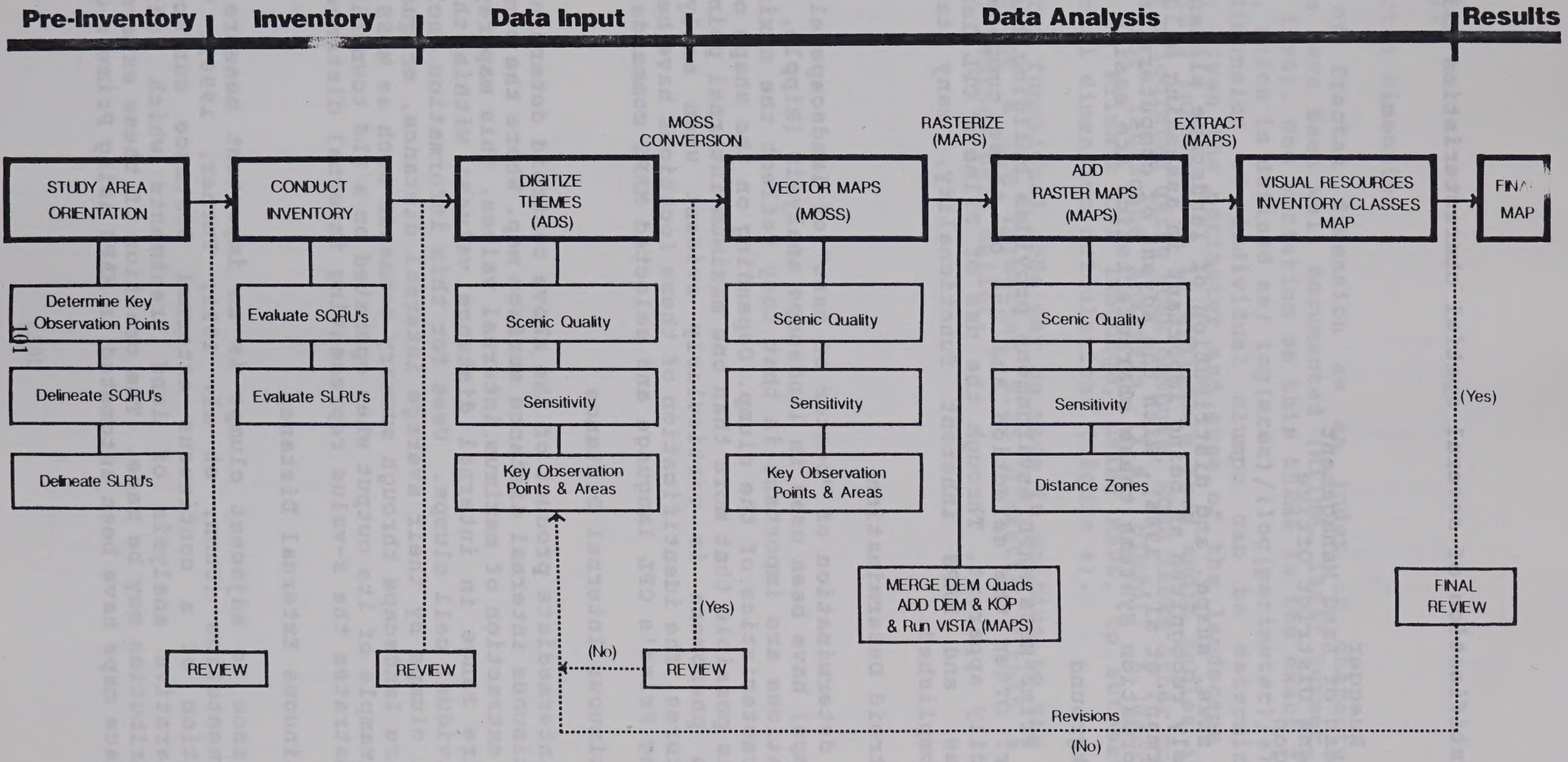

Pre-Inventory
Inventory
Data Input
Data Analysis
Results
STUDY AREA ORIENTATION
Determine Key Observation Points
Delineate SQRU's
Delineate SLRU's
REVIEW
CONDUCT INVENTORY
Evaluate SQRU's
Evaluate SLRU's
REVIEW
DIGITIZE THEMES (ADS)
Scenic Quality
Sensitivity
Key Observation Points & Areas
MOSS CONVERSION
VECTOR MAPS (MOSS)
Scenic Quality
Sensitivity
Key Observation Points & Areas
(Yes)
(No)
REVIEW
RASTERIZE (MAPS)
ADD RASTER MAPS (MAPS)
Scenic Quality
Sensitivity
Distance Zones
MERGE DEM Quads ADD DEM & KOP & Run VISTA (MAPS)
EXTRACT (MAPS)
VISUAL RESOURCES INVENTORY CLASSES MAP
FINA MAP
(Yes)
FINAL REVIEW
Revisions
(No)

Figure 8. VRM/MOSS Inventory & Analysis Process

Quantification of several spatial characteristics using MOSS/MAPS

by

Jay Ruegger
Bureau of Land Management
Eugene District Office
Oregon

The size, shape, and distribution of landscape elements have been widely recognized as being important in assessing wildlife habitat (Forman, et al., 1986). With the advent of computers and Geographic Information Systems these characteristics are easily determined.

Background

The Prime-MOSS/MAPS environment provides building blocks for the user. Often the selection and use of these components are not readily apparent. Through the use of Prime's CPL language, como files, and MAPS inherent functionality, many tasks can be accomplished.

Centroid Determination

The determination of "center of mass" of landscape elements (cell clumps) have been used in landscape analysis (Ripple, 1991). These locations are important in that they reflect the maximum internal characteristics of the clump. Depending on the shape of the clump, it is possible that more than one maximum internal point may exist. This phenomena is particularly evident when analyzing linear features. The identification of these locations have been automated using Prime's CPL language and selected MAPS commands (figure 1).

Continuous Internal Distance

An intermediate product of the above centroid determination is the continuous internal distance surface map. Where the centroid map is the extraction of maximum internal values, this map represents the entire range in internal distance values; within the bounds of individual cell clumps. Uses for this information include ranking cell clumps by their average internal distance, or quantifying an entire landscape through summary commands such as MOSS statistics. An example of its output when operated on a PLS township (figure 2) illustrates the z-value representing internal distance.

Continuous External Distance

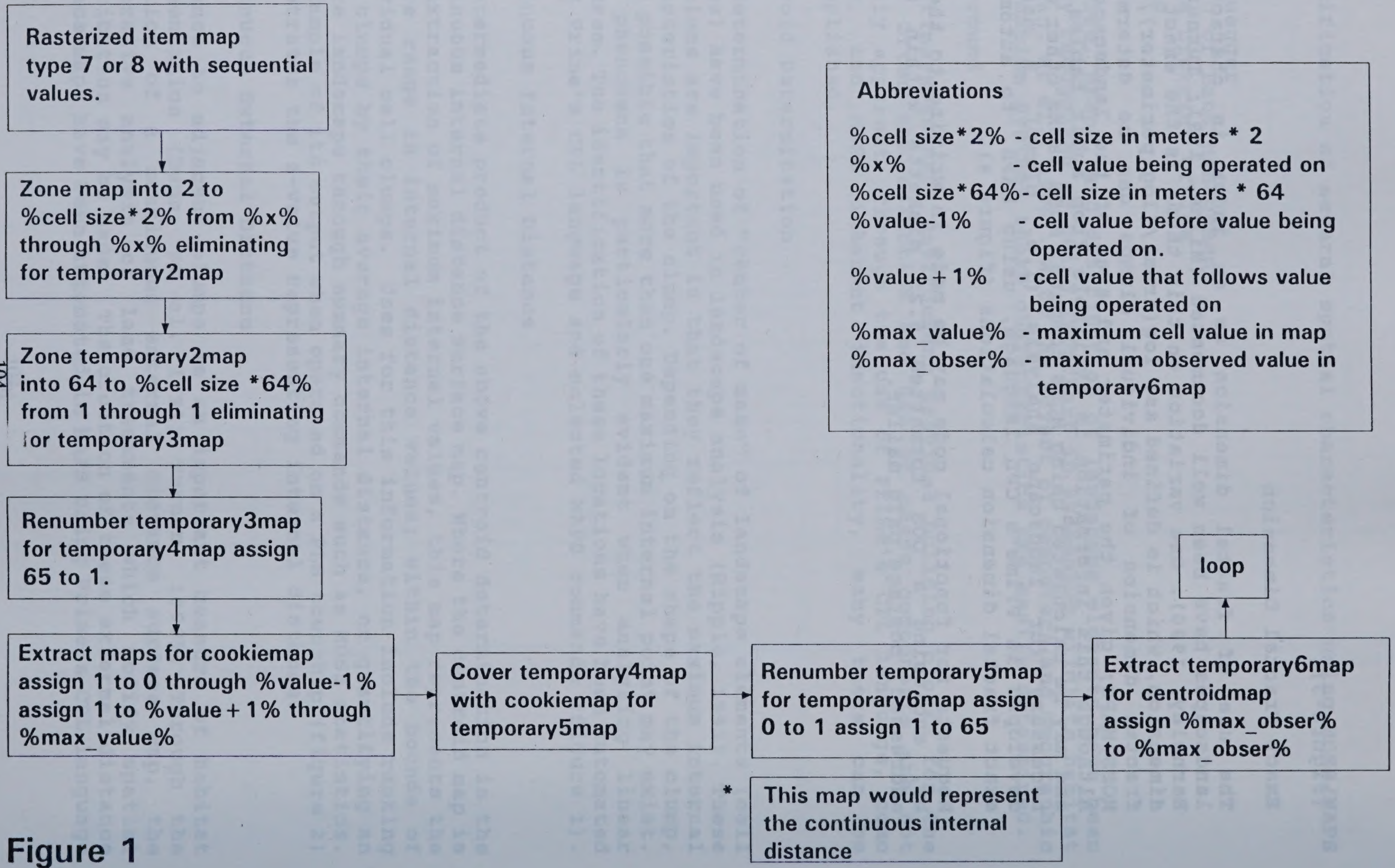
Distance to adjacent clumps is an important measure of habitat fragmentation (Dunn, et al. 1991; Turner, 1990). Through the creation of a continuous external distance surface map, the comparative analysis of land treatments which modify spatial distribution may be made. The creation of these external distance surface maps have been automated in MAPS using Prime's CPL language (figure 3).

Exact Fractal Dimension

The use of fractal dimension as an index in characterizing landscapes have been well documented (Milne, 1991; Turner, 1990; Barnsley, 1990). One variation on this theme is the exact fractal dimension, which is defined as; log(area)/(log(perimeter)/4). The fractal dimension of individual clumps can be determined in MOSS/MAPS; given the perimeter and area of the landscape patch. Although this information is available from audit tables in MOSS and may be calculated using MOSS compute, MOSS lacks other commands necessary for landscape analysis (i.e. clump). A macro was developed in Prime's CPL language, using MAPS, to automate the exact fractal dimension calculations (figure 4).

Requests for functional code may be made in writing to the author by, enclosing a DOS formatted 5.25 diskette within a self-addressed, postage paid mailer.

Centroid Determination



Rasterized item map type 7 or 8 with sequential values.

Zone map into 2 to %cell size*2% from %x% through %x% eliminating for temporary2map

Zone temporary2map into 64 to %cell size *64% from 1 through 1 eliminating for temporary3map

Renumber temporary3map for temporary4map assign 65 to 1.

Extract maps for cookiemap assign 1 to 0 through %value-1% assign 1 to %value+1% through %max_value%

Cover temporary4map with cookiemap for temporary5map

Renumber temporary5map for temporary6map assign 0 to 1 assign 1 to 65

Extract temporary6map for centroidmap assign %max_obser% to %max_obser%

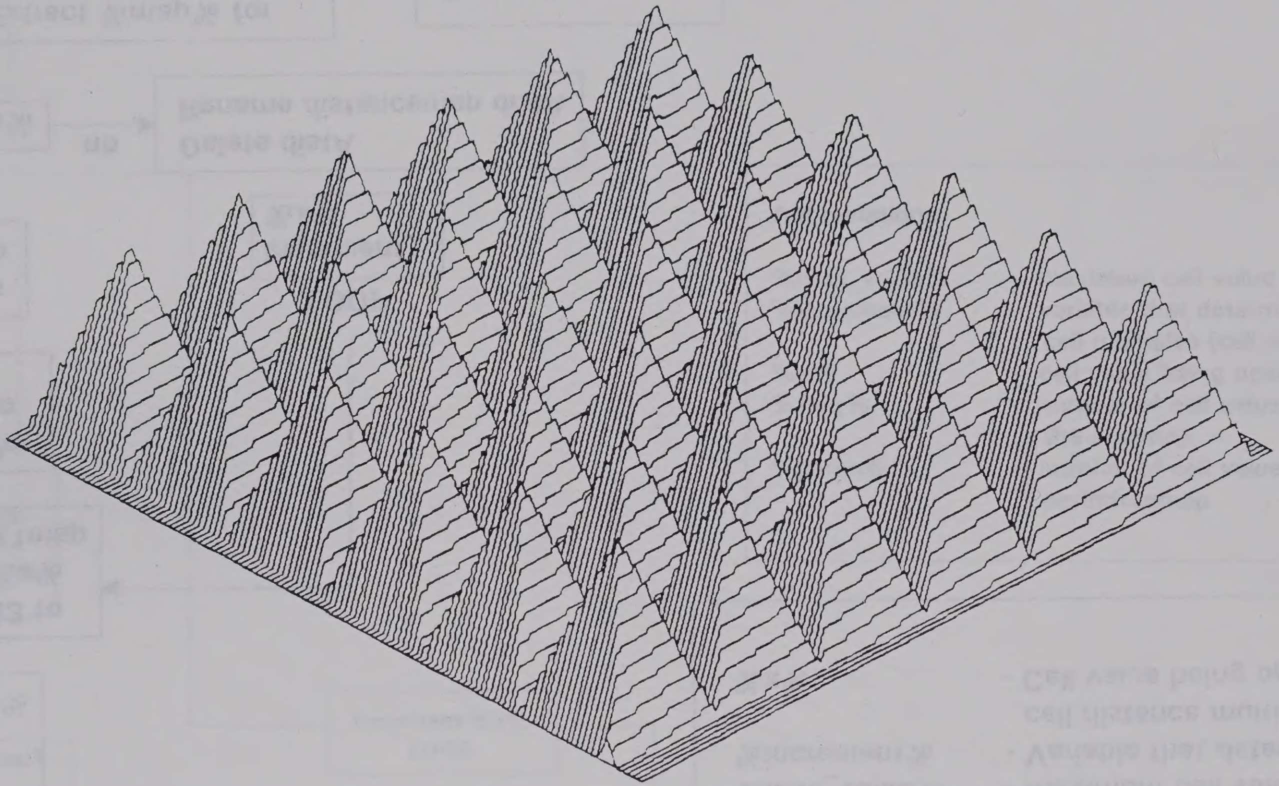
* This map would represent the continuous internal distance

Abbreviations

%cell size*2%	- cell size in meters * 2
%x%	- cell value being operated on
%cell size*64%	- cell size in meters * 64
%value-1%	- cell value before value being operated on.
%value+1%	- cell value that follows value being operated on
%max_value%	- maximum cell value in map
%max_obser%	- maximum observed value in temporary6map

Figure 1

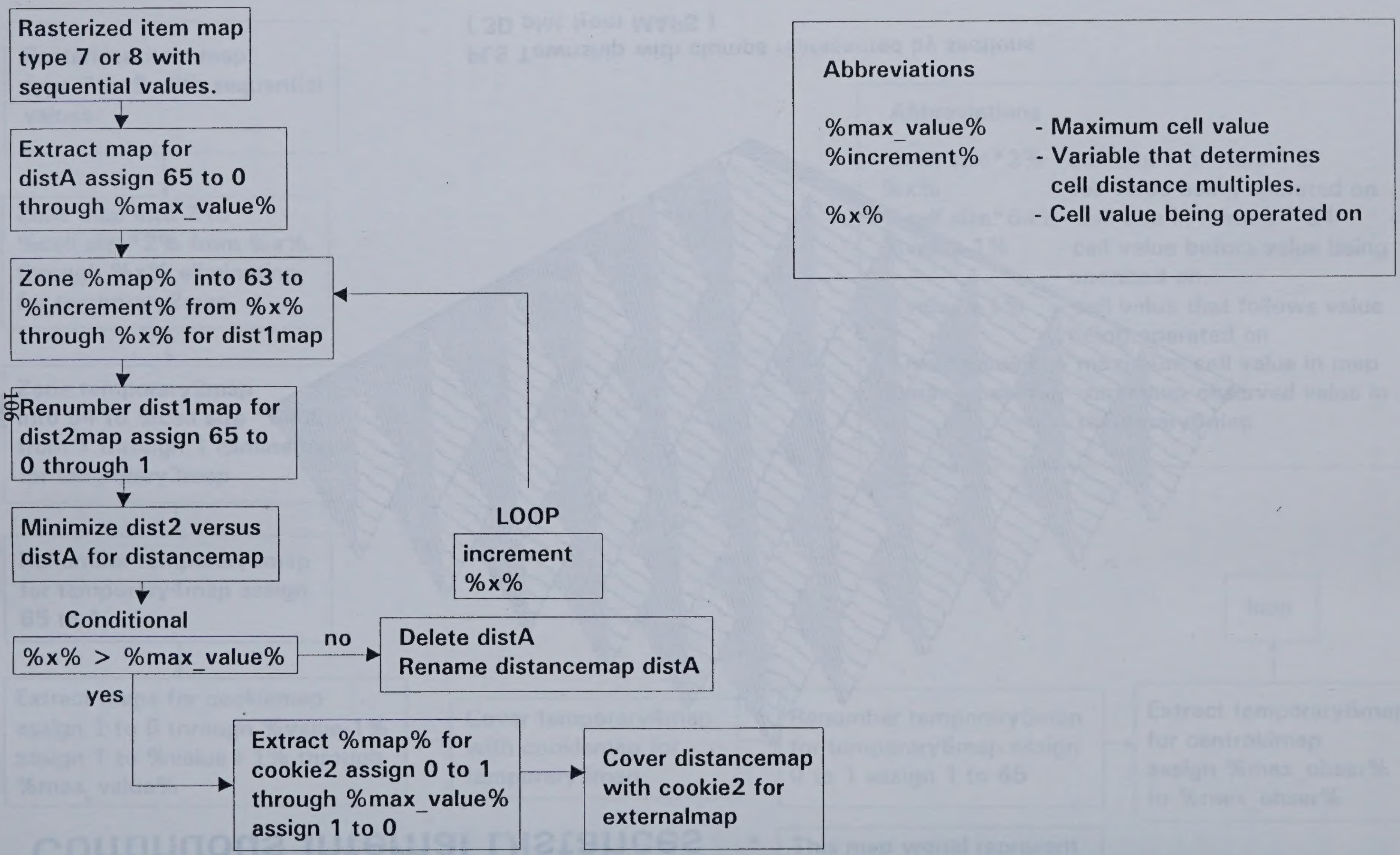
Continuous Internal Distances



PLS Township with clumps represented by sections
(3D plot from MAPS)

Figure 2

Continuous External Distances


Rasterized item map type 7 or 8 with sequential values.
Extract map for distA assign 65 to 0 through %max_value%
Zone %map% into 63 to %increment% from %x% through %x% for dist1map
Renumber dist1map for dist2map assign 65 to 0 through 1
Minimize dist2 versus distA for distancemap
Conditional
%x% > %max_value%
no
yes
Delete distA
Rename distancemap distA
LOOP
increment %x%
Extract %map% for cookie2 assign 0 to 1 through %max_value% assign 1 to 0
Cover distancemap with cookie2 for externalmap

Abbreviations

%max_value%	- Maximum cell value
%increment%	- Variable that determines cell distance multiples.
%x%	- Cell value being operated on

Figure 3

Exact Fractal Dimension in MAPS

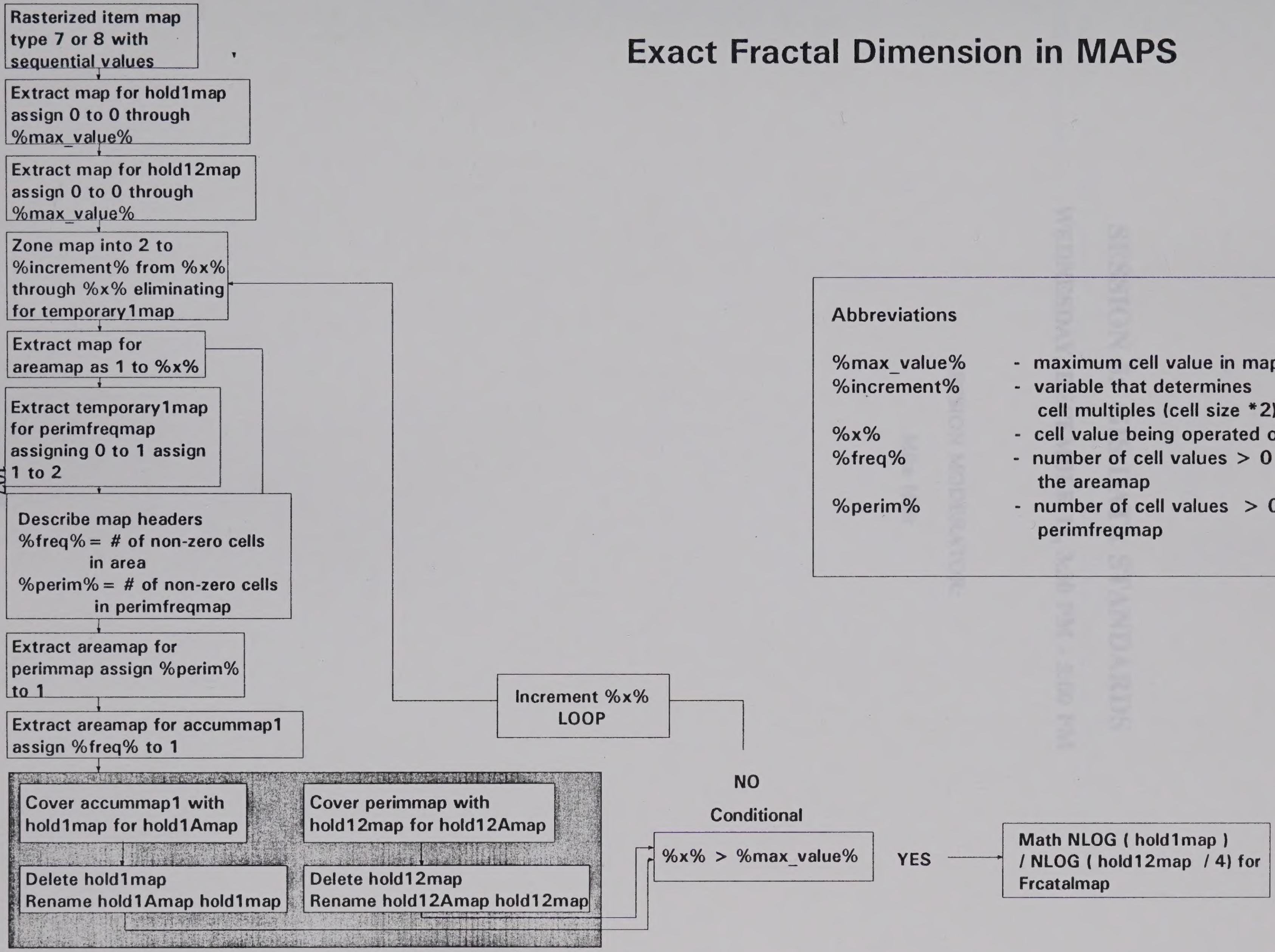

Rasterized item map type 7 or 8 with sequential values
Extract map for hold1map assign 0 to 0 through %max_value%
Extract map for hold12map assign 0 to 0 through %max_value%
Zone map into 2 to %increment% from %x% through %x% eliminating for temporary1map
Extract map for areamap as 1 to %x%
Extract temporary1map for perimfreqmap assigning 0 to 1 assign 1 to 2
Describe map headers %freq% = # of non-zero cells in area %perim% = # of non-zero cells in perimfreqmap
Extract areamap for perimmap assign %perim% to 1
Extract areamap for accummap1 assign %freq% to 1
Cover accummap1 with hold1map for hold1Amap
Cover perimmap with hold12map for hold12Amap
Delete hold1map Rename hold1Amap hold1map
Delete hold12map Rename hold12Amap hold12map
Increment %x% LOOP
NO
Conditional
%x% > %max_value%
YES
Math NLOG (hold1map) / NLOG (hold12map / 4) for Frcatalmap

Figure 4

Abbreviations

%max_value% - maximum cell value in map

%increment% - variable that determines cell multiples (cell size *2)

%x% - cell value being operated on

%freq% - number of cell values > 0 in the areamap

%perim% - number of cell values > 0 in perimfreqmap

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SESSION 5: GIS DATA STANDARDS

WEDNESDAY, DECEMBER 11, 3:30 PM - 5:00 PM

SESSION MODERATOR:

Mike Hutt

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THE SPATIAL DATA TRANSFER STANDARD (STDS)

Matthew McDermott
U.S. Geological Survey
Reston, Virginia

Editor's Note: The presenter may forward proceeding related materials before this talk is given. These materials were unavailable at the time of publication.

OMB Circular A-16 UPDATE

Bill Wilen
U.S. Fish and Wildlife Service
Washington, D.C.

Editor's Note: The presenter may forward proceeding related materials before this talk is given. These materials were unavailable at the time of publication.

DATA STANDARDS PANEL DISCUSSION:

"Spatial Data Standards: What are the Agencies Doing?"

PANEL MODERATOR

Mike Hutt
Branch of Mapping Sciences
BLM Service Center
P.O. Box 25047
Denver, Colorado 80225-0047

PANEL MEMBERS

Roseanne Hynes
Defense Mapping Agency
Washington, D.C.

Matthew McDermott
U.S. Geological Survey
Reston, Virginia

Peg Watry
U.S. Forest Service - Region 6
Portland, Oregon

Pat Green
Bureau of Land Management
Oregon State Office
Portland, Oregon 97213

Ray Hoem
Bureau of Land Management
Montana State Office
Billings, Montana

PRELIMINARY DISCUSSION TOPICS

- *Panel member introduction on their agency's activities in the area of spatial data standards.*
- *Identification of important spatial data collection efforts and the need for spatial data exchange coordination.*
- *Internal/external spatial data sharing and exchange within their agencies. Interdisciplinary and corporate spatial data modeling activities.*
- *Where are spatial data standards and technology headed?*

Notes from the Data Standards Panel Discussion.

Notes from the Data Standards Panel Discussion.

Notes from the Data Standards Panel Discussion.

SESSION 6: EMERGING GIS TECHNOLOGY

THURSDAY, DECEMBER 12, 8:30 AM - 12:00 PM

SESSION CHAIRPERSONS:

Bruce Keating and Jeff Nighbert

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GPS AS A FIELD DIGITIZING TOOL

J. Bruce Keating
Bureau of Land Management
Wyoming State Office
Cheyenne, Wyoming

Editor's Note: The presenter may forward proceeding related materials before this talk is given. These materials were unavailable at the time of publication.

24 hour 2D coverage at the present (3 satellites).

2 or more plus a bay station for resource mapping

1 unit accuracy is 100 meters 98% of the time (that is 1 football field) kind of equivalent to 100,000 K map scale or larger.
to ↑ the accuracy have a bay station.

Differential = stationary ± 5 meters 1:12,000 ; on the go ± 12 meter 1:24,000

GIS Uses
field resource data collection
update & maintenance
map accuracy testing
sampling for remote sensing

measure prescribed burns - used a helicopter to measure it

DEVELOPING CUSTOM GIS/LIS APPLICATION SOFTWARE, AVOIDING THE IMPLEMENTATION OF BOAT ANCHOR TECHNOLOGY

James R. Gazewood

BLM Service Center
Bureau of Land Management
U.S. Department of the Interior
P.O. Box 25047
Denver, Colorado 80225-0047

ABSTRACT

During GIS/LIS technology implementation, poor system requirements definition often results in the establishment of a system which critically omits the development and implementation of customized GIS/LIS application software. Consequently, a system is established that is frequently difficult to use for the majority of corporate personnel responsible for accomplishing their workloads on the system. In essence, an expensive technology "boat-anchor" is implemented. The system may crudely serve it's purpose, but requires significant force in the form of user training and systems specialist support.

Cost effective and highly successful implementations of GIS/LIS technology are attainable with good requirements engineering. Insight gained from the development of system requirements is pivotal to strategic planning and allows application software preliminary design to be initiated before a GIS is obtained. This paper discusses effective system requirements engineering to develop customized GIS/LIS application "front-ends" which enable more productive and cost-effective workload processing by a much larger number of corporate personnel.

DEFINITION OF THE PROBLEM

The Full Color Brochure Euphoria

Potential GIS/LIS users and their management are unrelentingly influenced by the wide variety of marketing and technical information which describes the state-of-the-art. For those likely purchasers studying the material, a euphoric feeling usually permeates the mind in which the "next" or the "latest" GIS/LIS technology available will provide a long awaited solution to processing a cumbersome workload.

Logically, the purchaser's next step is to perform a quick "detailed" analysis using the vendor full-color brochures. A number of "800" phone calls to the GIS sales representitives usually confirms that each of the systems under consideration can perform any wonder that is desired. Finally, an hour and a half of moving fingertips up and down the brochures by the selection team resolves the remaining decision issues.

By this time, it is obvious which system is the one that will cause sleepless nights in the anticipation of it's delivery. Funding commitments for the GIS/LIS procurement is usually established by the mortal effort of an accomplished corporate staffer who is both a smooth tongued-salesman and an effective beggar. Four meetings with the purchasing department to get the paperwork right, and the system is finally on order.

The software and hardware brochures are reviewed almost on a daily-basis until the delivery boxes arrive. For some unknown physiological reason, the purchaser always experiences a visual phenomenon whereby, the long-awaited products appear "rosier" and "rosier" each time the marketing brochures are reviewed and discussed amongst a group of eventual users during coffee.

We have all experienced the satisfaction of a "full color brochure euphoria". However, it often sets the stage for considerable disappointment and frustration.

The Green House Effect of Software Reality

After system installation, a week of vendor on-site training, and repeated training set mapping demonstrations to curious and skeptical management, the newness of the system quickly begins to wear off. Most of the recently trained users have gone back to doing work the way they did before - without the system. Some of these same people still cling to the hope that eventually, they will be able to use the system to accomplish their work.

Still a few users hack on - showing small but growing successes with the GIS/LIS technology. A decision is made by a progressive minded manager to extensively utilize the system to support a critical work backlog. A "techie" leads the effort, running into unforeseen software problems and limitations which require vender relayed work-arounds. Software macros are constructed to try and save time and for ease of use. The larger macros have become very complex, requiring adjustments and fixes to be made almost continually by the person who wrote them. No one else can assist because they do not easily understand how and why the macros were written. Management is updated on the workload accomplishment status. The supervisors are informed of the now apparent limitations in the deliverable GIS/LIS work products. Management seems to sense a limit of practicality in using this type of automation to support the original work requirements.

The unanticipated show stopper now takes place. The techie decides to leave the organization for a better position elsewhere. An immediate replacement was not available, as no single individual had enough experience to continue to make things work. Workload processing came to a sudden stand-still as the macros fell into a state of disrepair and no longer functioned. Help was summoned. It was difficult for the successor to understand how things were done, as coding design documentation and internal software commenting were never completed. A decision was made to scrap the entire project. It really wasn't as cost effective as everyone was lead to believe.

In subsequent meetings where the status of the now little used system was discussed, it was common for participants to experience disappointment, frustration and, for some strange reason, the meeting room always seems to become *really warm* to them. Speculation was that it was the building heating and cooling system. During a recent meeting, a senior manager known for his crew cut hair style, characterized the system as an expensive "boat anchor" of little use to his division staff. Rumor had it that the meeting room was *unbearably hot* that day.

AVOIDING THE IMPLEMENTATION OF THE "BOAT ANCHOR"

Where is Custom GIS/LIS Application Software Development Headed?

State-of-the-art GIS/LIS technology is now proving to be an extremely synoptic tool providing greater data integration of other kinds of information. These systems now work with raster and vector GIS data, CAD data, scanned images, video, text, and still others. Current capabilities exist for the construction and implementation of extensive custom GIS/LIS application "front-ends". When specifically designed to support large segments of a business' workload, these application front-ends prove to be very cost-effective and modernizational in nature.

As an example, The U.S. Department of Defense (DOD) and civilian Federal agencies have recognized the critical business utility of custom GIS/LIS application software. In doing so, very large GIS/LIS applications have been achieved or are being planned.

Successful development and delivery of custom GIS/LIS applications of these sizes and complexity require system engineering practices which must be extremely effective. Industry horror stories of excessive contractor cost overruns during the 1980's exist. In some instances, causes were a direct result of ineffective contractor system engineering practices.

Recently developed and implemented engineering standards are now overcoming the chronic cost overrun and performance problems characteristic of the past decade. These processes can deliver highly cost-effective systems. The overwhelming success of the system engineering processes used to develop and deliver the advanced technology employed during the Persian Gulf War can be used to illustrate this point.

It is estimated that a large portion of custom GIS/LIS software applications being developed today are being constructed in a piece-meal system engineering approach. Applications developed from macro languages generally start small and have discrete functionality. When integrated to support a large application front-end, the integrated macros often do not adequately support more robust user functional and data requirements. A redesign of the application macros to a structured design may be necessary to support greater LIS/GIS functionality and data requirements, allow easier software maintenance, and to minimize the number and complexity of software bugs.

Compounding the piece-meal construction of custom GIS/LIS application software, is the growing need for users to access and manipulate large tabular databases using a relational database software integrated within a GIS. The application developer must now effectively develop software support for the user's relational database record management needs with their existing spatial processing capabilities. The definition, development, and successful implementation of custom applications to meet a large number of GIS/LIS user requirements has become a system engineering discipline in itself.

The private sector is now moving into the development and use of large, custom GIS/LIS application front-ends with a limited number of individuals who have large scale GIS/LIS system engineering expertise. To assist in GIS/LIS definition and development, a commercial market is now being supported by software vendors by providing system engineering consulting, contract coding support, integrated computer aided system engineering (I-CASE) capabilities, and by facilitating the availability of third party software application specialists. All of these resources are excellent, but may provide little help when a large application is to be developed for an area where no specialized knowledge exists. Success then becomes more a function of expertise with large scale GIS/LIS system engineering methodology and standards.

GIS/LIS support personnel from the Department of Defense and civilian Federal agencies have made significant inroads into developing and managing complex levels of in-house or commercially developed GIS/LIS application front-ends. As a result, considerable insight has been gained into what is required for success. The Department of Defense Military Standard 2167A and 2168 have recently been applied to manage large GIS/LIS applications. This systems development and maintenance standard is proving particularly beneficial in defining, organizing, and managing very large arrays of GIS/LIS software and data requirements.

Products of the Requirements Analysis

For the basis of this paper, we shall presume that a project charter and a detailed strategic project (task) plan have already been developed and implemented. The job at hand is to perform the **system requirements analysis** necessary for the development of a corporation's custom GIS/LIS application front-end. To illustrate the products of the requirements analysis, this paper describes the system engineering standards that are met when utilizing DOD-MIL-STD-2167A.

An effective requirements engineering methodology is one that: 1) quickly builds on existing corporate user and management GIS/LIS automation insight, 2) is simple, logically organized, and structured; 3) driven through substantial user involvement by employing small schedule-driven rapid application development (RAD) teams, and 4) results in constructive reviews by the remaining portion of the organization necessary to realize corporate-wide business goals and to develop the feeling of ownership. When managed and applied effectively, MIL-STD-2167A works extremely well in meeting these criteria, plus many more.

Using MIL-STD-2167A, there are two stages during the system requirements analysis process. The first is the documentation of the *functional baseline*, while, the second is the documentation of the *allocated baseline*. The functional baseline establishes the scope of the automated workload processing capabilities that shall be supported by the new system. Once the sideboards of the functional baseline are finalized by user and management review, work can begin to flush out detailed requirements which result in the documentation of the allocated baseline.

During the documentation of the functional baseline, two very high-level (general) specifications are produced:

1. **System/Segment Specification** (SSS) - logically organized general descriptions of GIS/LIS automation candidates as compiled by rapid application development (RAD) teams. If the GIS/LIS application front-end is a stand-alone system, the document will be referred to as a "System Specification". In the case where a GIS/LIS application is a segment of a larger system, the document will be referred to as a "Segment Specification".

   This document is fairly easy to produce. It focuses and organizes high level user requirements. See **Fig. 1A** and **Fig. 1B.**

   The System/Segment Specification is primarily written by the RAD teams with assistance from system analysts. RAD teams are relatively small, four to six users, all of which should be hand picked by management. These individuals must possess extensive business workload experience with the unique committed champion attitude toward applying automation technology to their area of business responsibility.

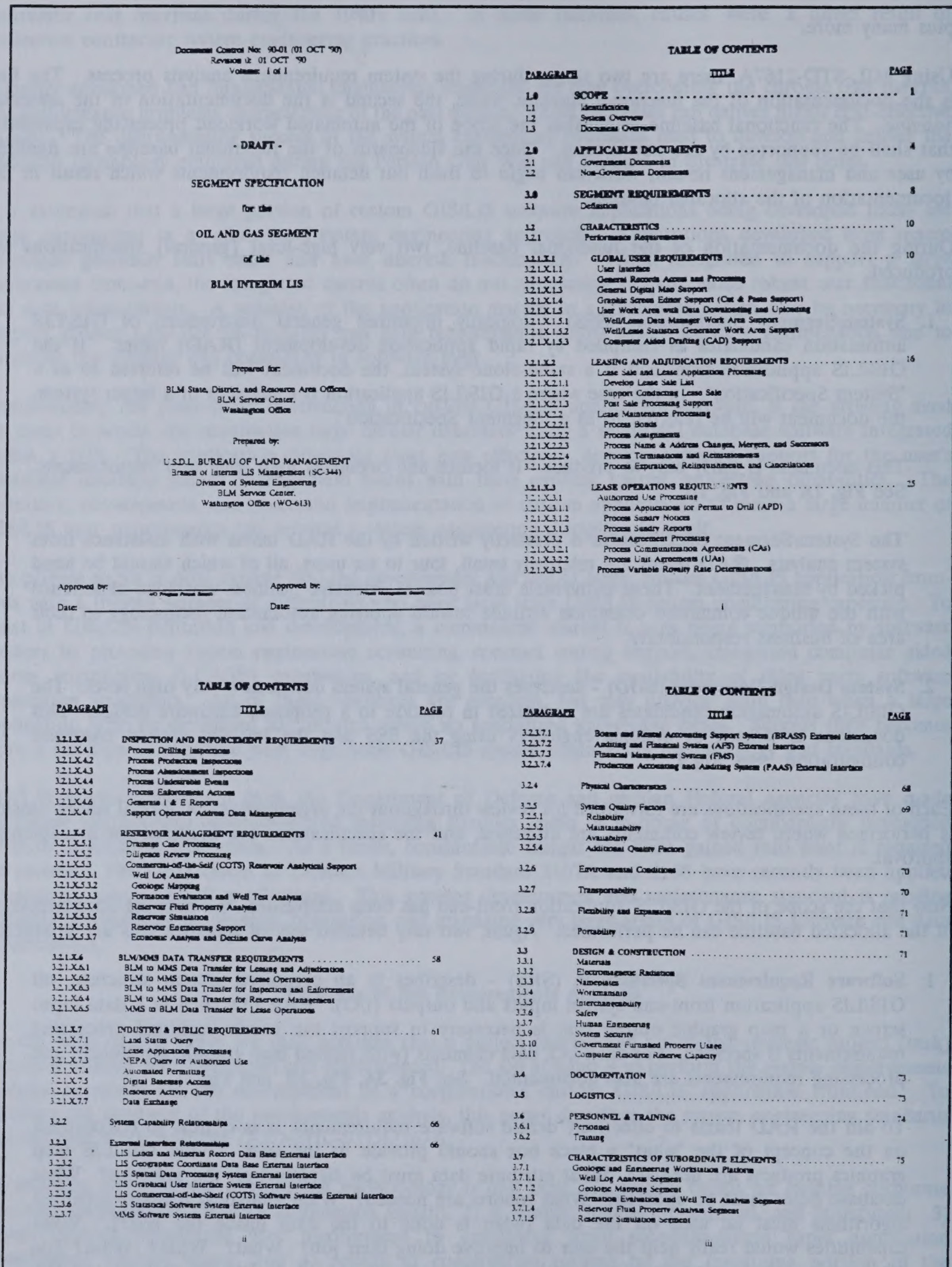
2. **System Design Document** (SDD) - describes the general system design at a very high level. The GIS/LIS automation candidates are organized in relation to a proposed hardware design. This document is written by systems engineers using the SSS and the initially desired hardware configuration. See **Fig 2.**

Each of these specifications are forwarded for review throughout the organization. A formal review session is performed where review comments are discussed, and the specifications are finalized for management approval.

Now that the scope of the GIS/LIS application front-end has been established, the detailed documentation of the allocated baseline can be performed. Again, two very detailed sets of specifications are produced:

1. **Software Requirement Specification** (SRS) - describes in an organized system structure, all GIS/LIS application front-end system inputs and outputs (I/O). Each I/O, such as a data input screen or a map graphic output that is necessary to support the user's workload processing requirements is specified. For each I/O, data elements (with related map graphic attributes), and processing requirements are also documented. See **Fig. 3A**, **Fig. 3B**, and **Fig 3C.**

   To aid the RAD teams to effectively define software requirements, it is critical to concentrate on the concept of the "what" a black box should provide to the user. What GIS/LIS map graphics products are needed? What attribute data must be displayed on the graphics? What database fields must be updated? What reports are needed? What analytical industry accepted algorithms must be used on the data (what is done to the data inside the box?). What capabilities would really help the user to improve doing their job? What? What? What? Too often, the users become concerned with how the software should do it's job and less on the "required" products they need. They must be concerned with identifying all software capabilities



Document Control No: 90-01 (01 OCT '90)
Revision #: 01 OCT '90
Volume: 1 of 1

- DRAFT -

SEGMENT SPECIFICATION

for the

OIL AND GAS SEGMENT

of the

BLM INTERIM LIS

Prepared for:

BLM State, District, and Resource Area Offices,
BLM Service Center,
Washington Office

Prepared by:

U.S.D.I. BUREAU OF LAND MANAGEMENT
Branch of Interim LIS Management (SC-344)
Division of Systems Engineering
BLM Service Center,
Washington Office (WO-613)

Approved by: ______________________ Approved by: ______________________

Date: ______________________ Date: ______________________

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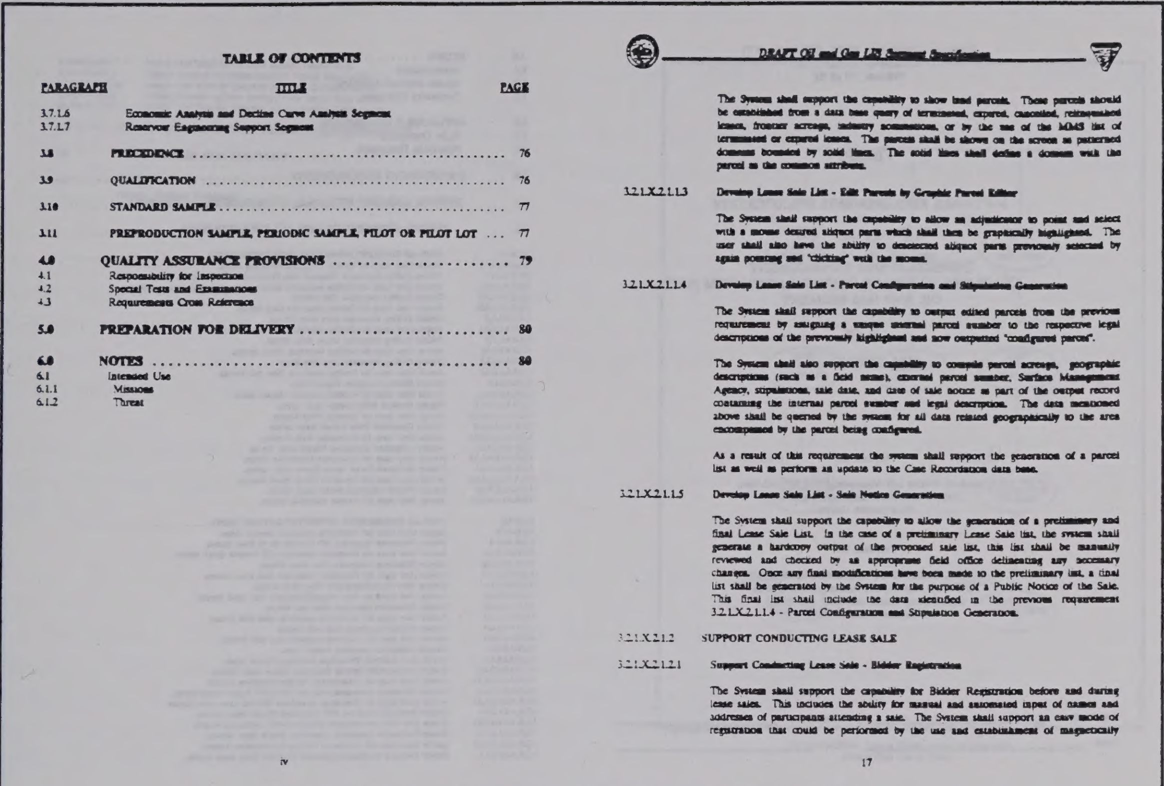
Fig. 1A - System/Segment Specification (SSS) Structure



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DRAFT Oil and Gas LIS Segment Specification

The System shall support the capability to show land parcels. These parcels should be established from a data base query of terminated, expired, cancelled, relinquished leases, frontier acreage, industry nominations, or by the use of the MMS list of terminated or expired leases. The parcels shall be shown on the screen as patterned domains bounded by solid lines. The solid lines shall define a domain with the parcel as the common attribute.

3.2.1.X.2.1.1.3 Develop Lease Sale List - Edit Parcels by Graphic Parcel Editor

The System shall support the capability to allow an adjudicator to point and select with a mouse desired aliquot parts which shall then be graphically highlighted. The user shall also have the ability to deselected aliquot parts previously selected by again pointing and "clicking" with the mouse.

3.2.1.X.2.1.1.4 Develop Lease Sale List - Parcel Configuration and Stipulation Generation

The System shall support the capability to output edited parcels from the previous requirement by assigning a unique internal parcel number to the respective legal descriptions of the previously highlighted and now outputted "configured parcel".

The System shall also support the capability to compile parcel acreage, geographic descriptions (such as a field name), external parcel number, Surface Management Agency, stipulations, sale date, and date of sale notice as part of the output record containing the internal parcel number and legal description. The data mentioned above shall be queried by the system for all data related geographically to the area encompassed by the parcel being configured.

As a result of this requirement the system shall support the generation of a parcel list as well as perform an update to the Case Recordation data base.

3.2.1.X.2.1.1.5 Develop Lease Sale List - Sale Notice Generation

The System shall support the capability to allow the generation of a preliminary and final Lease Sale List. In the case of a preliminary Lease Sale list, the system shall generate a hardcopy output of the proposed sale list, this list shall be manually reviewed and checked by an appropriate field office delineating any necessary changes. Once any final modifications have been made to the preliminary list, a final list shall be generated by the System for the purpose of a Public Notice of the Sale. This final list shall include the data identified in the previous requirement 3.2.1.X.2.1.1.4 - Parcel Configuration and Stipulation Generation.

3.2.1.X.2.1.2 SUPPORT CONDUCTING LEASE SALE

3.2.1.X.2.1.2.1 Support Conducting Lease Sale - Bidder Registration

The System shall support the capability for Bidder Registration before and during lease sales. This includes the ability for manual and automated input of names and addresses of participants attending a sale. The System shall support an easy mode of registration that could be performed by the use and establishment of magnetically

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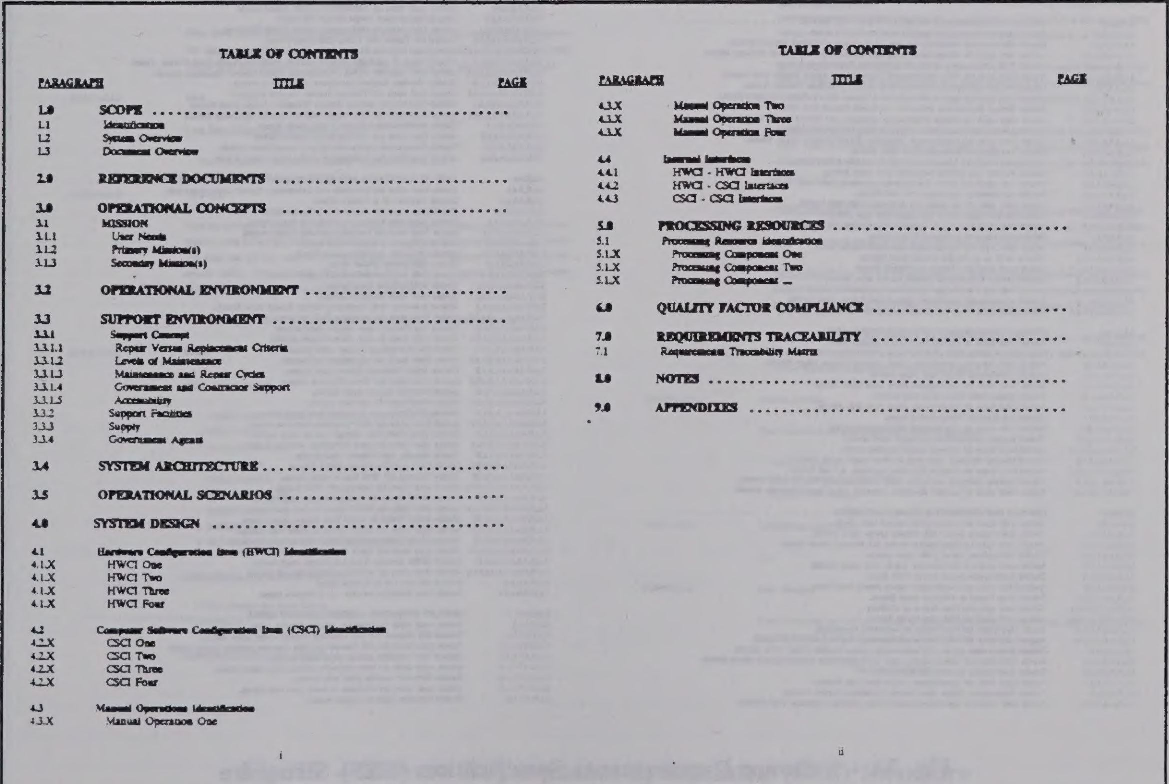
Fig. 1B - System/Segment Specification (SSS) Structure



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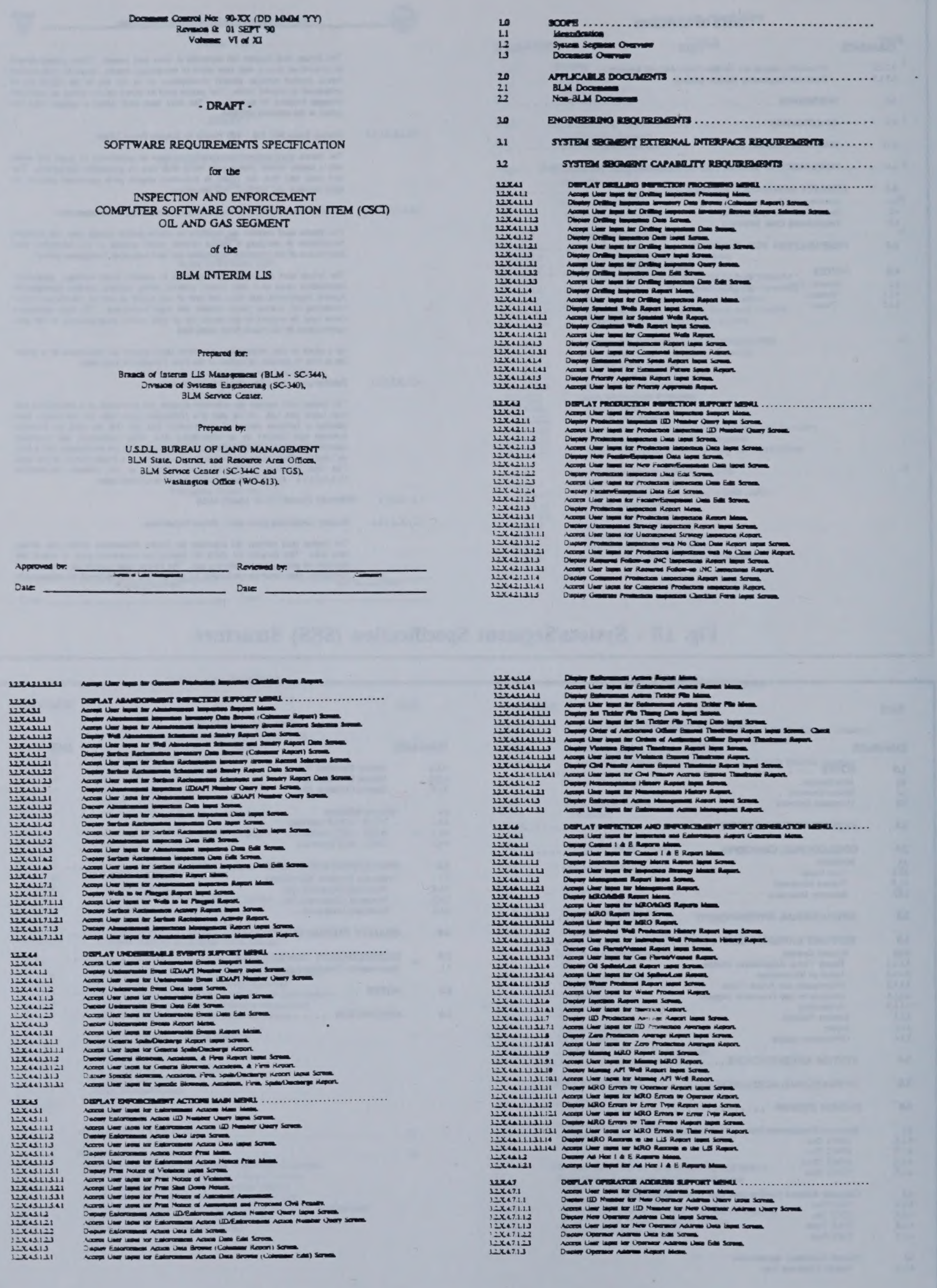

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Revision 0: 01 SEPT '90
Volume: VI of XI

- DRAFT -

SOFTWARE REQUIREMENTS SPECIFICATION

for the

INSPECTION AND ENFORCEMENT
COMPUTER SOFTWARE CONFIGURATION ITEM (CSCI)
OIL AND GAS SEGMENT

of the

BLM INTERIM LIS

Prepared for:

Branch of Interim LIS Management (BLM - SC-344),
Division of Systems Engineering (SC-340),
BLM Service Center.

Prepared by:

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BLM State, District, and Resource Area Offices,
BLM Service Center (SC-344C and TGS),
Washington Office (WO-613).

Approved by: ____________________ Reviewed by: ____________________

Date: ____________________ Date: ____________________

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1.3 Document Overview

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3.2.X.4.2 DISPLAY PRODUCTION INSPECTION SUPPORT MENU ....

3.2.X.4.3 DISPLAY ABANDONMENT INSPECTION SUPPORT MENU ....

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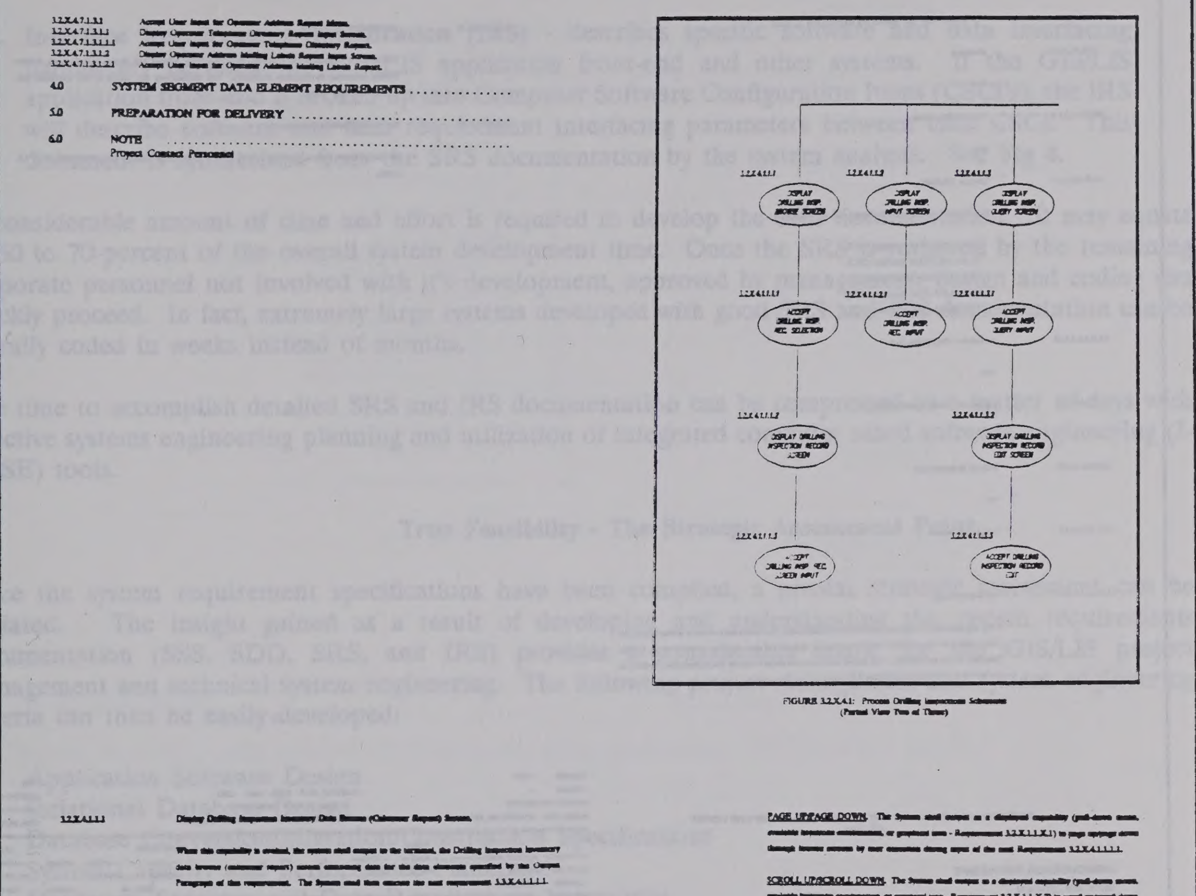
Fig. 3A - Software Requirements Specification (SRS) Structure



3.2.X.4.1.1.1
DISPLAY DRILLING INSP. BROWSE SCREEN
3.2.X.4.1.1.2
DISPLAY DRILLING INSP. INPUT SCREEN
3.2.X.4.1.1.3
DISPLAY DRILLING INSP. QUERY SCREEN
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ACCEPT DRILLING INSP. REC. SELECTION
3.2.X.4.1.1.2.1
ACCEPT DRILLING INSP. REC. INPUT
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ACCEPT DRILLING INSP. QUERY INPUT
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3.2.X.4.7.1.3.1.1.1 Accept User Input for Operator Telephone Directory Report.
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3.2.X.4.7.1.3.1.2.1 Accept User Input for Operator Address Mailing Labels Report.

4.0 SYSTEM SEGMENT DATA ELEMENT REQUIREMENTS ....
5.0 PREPARATION FOR DELIVERY ....
6.0 NOTE ....
Project Contact Personnel

FIGURE 3.2.X.4.1: Process Drilling Inspections Schematic
(Partial View Two of Three)

3.2.X.4.1.1.1 Display Drilling Inspection Inventory Data Browse (Columnar Report) Screen.

When this capability is invoked, the system shall output to the terminal, the Drilling Inspection Inventory data browse (columnar report) screen containing data for the data elements specified by the Output Paragraph of this requirement. The System shall then execute the next requirement 3.3.X.4.1.1.1.1.

3.2.X.4.1.1.1.1 Input

Input Data (Other) - Internal System Processing

This requirement is internally executed by Requirement 3.2.X.4.1.1.

3.2.X.4.1.1.1.2 Processing

When this capability is invoked, the System shall output to the terminal a browse (columnar report) screen containing data for the data elements specified in the Output Paragraph of this requirement. The system shall query the LIS data base for all wells that have a "drilling" or "spudded" WELL STATUS data element values. After outputting the screen, the System shall then execute the next requirement 3.2.X.4.1.1.1.1 as specified in the Internal Interface Paragraph.

The output records shall be sorted by FIELD NAME and WELL NUMBER data elements.

3.2.X.4.1.1.1.3 Output

Output Data Elements

1. AMERICAN PETROLEUM INSTITUTE WELL NUMBER
2. FIELD NAME
3. OPERATOR NAME
4. WELL NAME
5. WELL STATUS
6. INSPECTION DATE
7. INSPECTION TYPE
8. INSPECTION PRIORITY
9. INCIDENT OF NONCOMPLIANCE ISSUED (Yes or No)

Output (Other) - System Internal Execution

3.2.X.4.1 (Output for Error Check),
3.2.X.4.1.1.1.1

Output Data (Other) - User Interface

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PAGE UP/PAGE DOWN. The System shall output as a displayed capability (pull-down menu, available keystroke combination, or graphical icon - Requirement 3.2.X.1.1.X.1) to page up/page down through browse screens by user execution during input of the next Requirement 3.2.X.4.1.1.1.1.

SCROLL UP/SCROLL DOWN. The System shall output as a displayed capability (pull-down menu, available keystroke combination, or graphical icon - Requirement 3.2.X.1.1.X.2) to scroll up/scroll down through a browse screen by user execution during input of the next Requirement 3.2.X.4.1.1.1.1.

SCROLL RIGHT/SCROLL LEFT. The System shall output as a displayed capability (pull-down menu, available keystroke combination, or graphical icon - Requirement 3.2.X.1.1.X) to scroll right/scroll left through a browse screen by user execution during input of the next Requirement 3.2.X.4.1.1.1.1.

PRINT RECORD(S). The System shall output as a displayed capability (pull-down menu, available keystroke combination, or graphical icon - Requirement 3.2.X.1.1.X.3) to print single or multiple records for a browse screen by user execution during input of the next Requirement 3.2.X.4.1.1.1.1.

SAVE RECORD(S). The System shall output as a displayed capability (pull-down menu, available keystroke combination, or graphical icon - Requirement 3.2.X.1.1.X) to save single or multiple records from the browse screen by user execution during input of the next Requirement 3.2.X.4.1.1.1.1.

CANCEL. The System shall output as a displayed capability (pull-down menu, available keystroke combination, or graphical icon - Requirement 3.2.X.1.1.X) to cancel or exit from the browse screen by user execution during input of the next Requirement 3.2.X.4.1.1.1.1.

3.2.X.4.1.1.1.4 Internal Interface

This requirement internally interfaces with requirement(s):

3.2.X.4.1.1 (Input),
3.2.X.4.1 (Output for Error Check),
3.2.X.4.1.1.1.1 (Output).

3.2.X.4.1.1.1.5 Limits/Ranges and Values

N/A

3.2.X.4.1.1.1.6 Error Checking

If the System does not find any records in the LIS data base as specified by the input criteria for the input data elements, the System shall display the following message:

"No Records Found"

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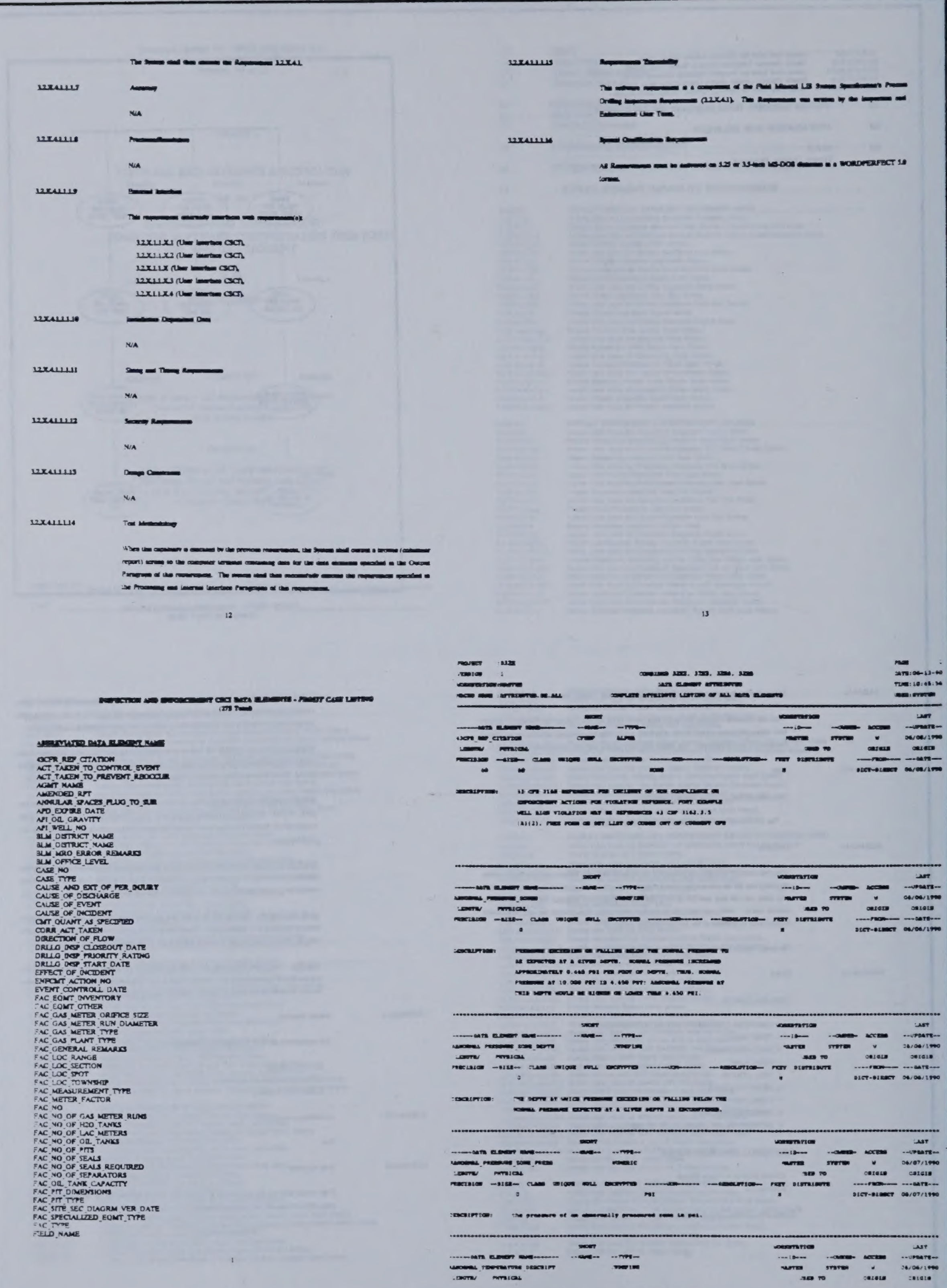
Fig. 3B - Software Requirements Specification (SRS) Structure



ABBREVIATED DATA ELEMENT NAME

43CFR_REF_CITATION
ACT_TAKEN_TO_CONTROL_EVENT
ACT_TAKEN_TO_PREVENT_REOCCUR
AGMT_NAME
AMENDED_RPT
ANNULAR_SPACES_PLUG_TO_SUR
APD_EXPIRE_DATE
API_OIL_GRAVITY
API_WELL_NO
BLM_DISTRICT_NAME
BLM_DISTRICT_NAME
BLM_MRO_ERROR_REMARKS
BLM_OFFICE_LEVEL
CASE_NO
CASE_TYPE
CAUSE_AND_EXT_OF_PER_INJURY
CAUSE_OF_DISCHARGE
CAUSE_OF_EVENT
CAUSE_OF_INCIDENT
CMT_QUANT_AS_SPECIFIED
CORR_ACT_TAKEN
DIRECTION_OF_FLOW
DRLLG_INSP_CLOSEOUT_DATE
DRLLG_INSP_PRIORITY_RATING
DRLLG_INSP_START_DATE
EFFECT_OF_INCIDENT
ENFCMT_ACTION_NO
EVENT_CONTROLL_DATE
FAC_EQMT_INVENTORY
FAC_EQMT_OTHER
FAC_GAS_METER_ORIFICE_SIZE
FAC_GAS_METER_RUN_DIAMETER
FAC_GAS_METER_TYPE
FAC_GAS_PLANT_TYPE
FAC_GENERAL_REMARKS
FAC_LOC_RANGE
FAC_LOC_SECTION
FAC_LOC_SPOT
FAC_LOC_TOWNSHIP
FAC_MEASUREMENT_TYPE
FAC_METER_FACTOR
FAC_NO
FAC_NO_OF_GAS_METER_RUNS
FAC_NO_OF_H2O_TANKS
FAC_NO_OF_LAC_METERS
FAC_NO_OF_OIL_TANKS
FAC_NO_OF_PITS
FAC_NO_OF_SEALS
FAC_NO_OF_SEALS_REQUIRED
FAC_NO_OF_SEPARATORS
FAC_OIL_TANK_CAPACITY
FAC_PIT_DIMENSIONS
FAC_PIT_TYPE
FAC_SITE_SEC_DIAGRM_VER_DATE
FAC_SPECIALIZED_EQMT_TYPE
FAC_TYPE
FIELD_NAME

Fig. 3C - Software Requirements Specification (SRS) Structure

and the data that the system must use to support their workload automation candidates.

2. **Interface Requirement Specification (IRS)** - describes specific software and data interfacing parameters between the GIS/LIS application front-end and other systems. If the GIS/LIS application front-end is broken up into Computer Software Configuration Items (CSCI's), the IRS will describe software and data requirement interfacing parameters between each CSCI. This document is synthesized from the SRS documentation by the system analysts. See **Fig 4.**

A considerable amount of time and effort is required to develop the SRS documentation. It may equate to 60 to 70-percent of the overall system development time. Once the SRS is reviewed by the remaining corporate personnel not involved with it's development, approved by management, design and coding can quickly proceed. In fact, extremely large systems developed with good SRS and IRS documentation can be literally coded in weeks instead of months.

The time to accomplish detailed SRS and IRS documentation can be compressed to a matter of days with effective systems engineering planning and utilization of integrated computer aided software engineering (I-CASE) tools.

True Feasibility - The Strategic Assessment Point

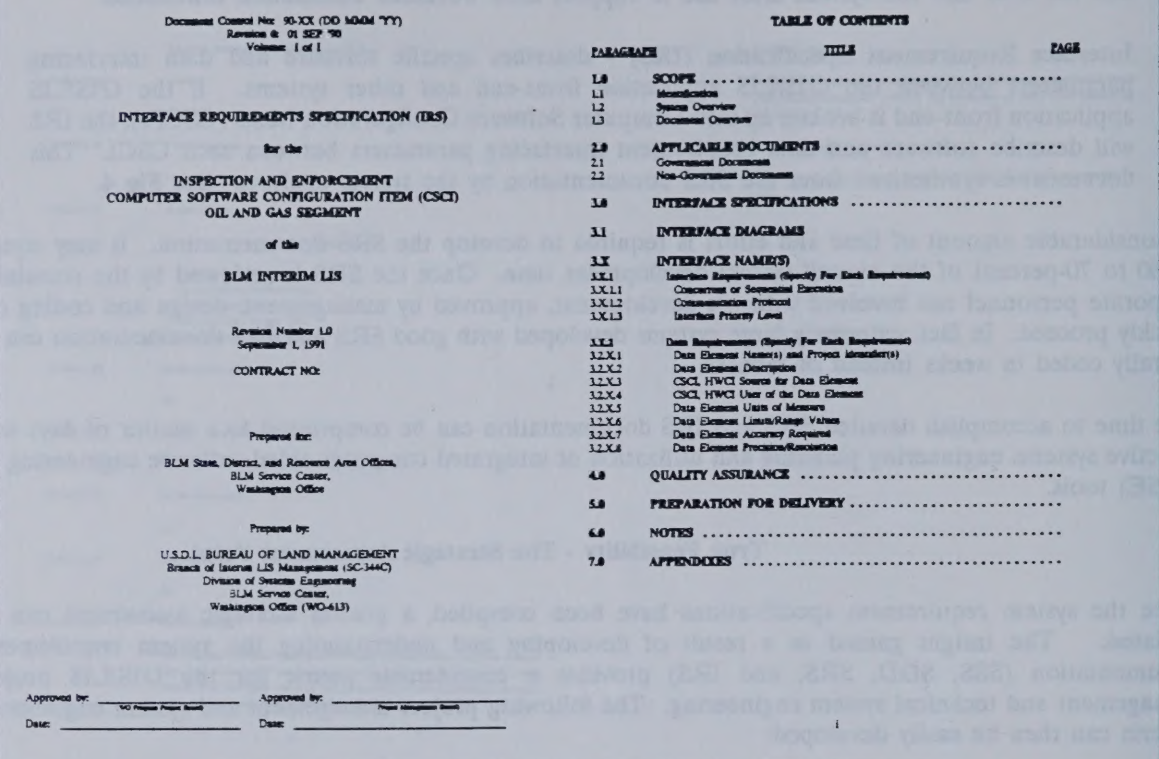
Once the system requirement specifications have been compiled, a pivotal strategic assessment can be initiated. The insight gained as a result of developing and understanding the system requirements documentation (SSS, SDD, SRS, and IRS) provides a considerable *metric* for the GIS/LIS project management and technical system engineering. The following project management and system engineering criteria can then be easily developed:

- Application Software Design
- Relational Database Design
- Database Conversion/Migration/Construction Specifications
- System Capacity and Performance Planning
- Hardware, Software and Data Requirement Inventories
- Detailed System Cost Assessments
- Incremental Build or Full-Implementation Strategy
- Vendor Software Assessment
    - In-house Development
    - Vendor Assistance
    - Contractor Assistance
    - Out-sourcing and Piloting
    - Prototype Development and Assessment
- Software Testing and Assessment based on Contract Deliverables

It should now be apparent, that the system requirements documentation is crucial to providing project management success for developing large-scale custom GIS/LIS application front-ends. A more detailed discussion on the additional benefits as related to software configuration management and the next life cycle management are worthy of a separate paper. The Author would like to leave the reader with a general understanding of the system engineering products that are developed during the requirements analysis using the DOD-MIL-STD-2167A system engineering standards.

CONCLUSION

Too often, GIS/LIS systems are implemented that do not adequately meet short and long-term user workload processing requirements. As larger and more complex GIS/LIS application front-ends are developed, it is critical that effective system engineering processes be utilize to offset implementation risks and to provide an engineering process to overcome a multitude of problems characteristic of piece-meal development.



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INTERFACE REQUIREMENTS SPECIFICATION (IRS)

for the

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BLM INTERIM LIS

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Prepared by:

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Branch of Interim LIS Management (SC-344C)
Division of Systems Engineering
BLM Service Center,
Washington Office (WO-613)

Approved by: ____________________ Approved by: ____________________
Date: ____________________ Date: ____________________

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3.X	INTERFACE NAME(S)	
3.X.1	Interface Requirements (Specify For Each Requirement)	
3.X.1.1	Concurrent or Sequential Execution	
3.X.1.2	Communication Protocol	
3.X.1.3	Interface Priority Level	
3.X.2	Data Requirements (Specify For Each Requirement)	
3.2.X.1	Data Element Name(s) and Project Identifier(s)	
3.2.X.2	Data Element Description	
3.2.X.3	CSCI, HWCI Source for Data Element	
3.2.X.4	CSCI, HWCI User of the Data Element	
3.2.X.5	Data Element Units of Measure	
3.2.X.6	Data Element Limits/Range Values	
3.2.X.7	Data Element Accuracy Required	
3.2.X.8	Data Element Precision/Resolution	
4.0	QUALITY ASSURANCE	
5.0	PREPARATION FOR DELIVERY	
6.0	NOTES	
7.0	APPENDIXES	

i

Fig. 4 - Interface Requirements Specification (IRS) Structure

ACKNOWLEDGEMENTS

The Author would like to thank the management of the Branch of GIS Services (SC-344), Division of Systems Operations, Maintenance, and Support, BLM Service Center, Denver, Colorado for their approval and support in the writing and presentation of this paper.

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The SLF System:
Automating the MOSS "SELECT-FROM" Command

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27 November, 1991

Introduction

When working with master MOSS maps which comprise the Western Oregon Digital Database (WODDB), it is often necessary to create a new map containing a subset of subjects from these master maps. Infotec Development Inc., on contract with BLM/Oregon, has developed a program to automate this process, known as the SLF system. The SLF system uses the MOSS SELECT FROM command to create new individual or merged maps from already existing master maps, thus making it possible to create new MOSS maps, and even entire themes, in an automated fashion.

WODDB Needs

The Western Oregon Digital Database is comprised of a set of master MOSS maps which are considered "base themes". These themes have been verified at several levels as being accurate, and cannot be changed without a formal approval process. During many WODDB analytic processes, it is often necessary to select a subset of subjects from these themes in order to create a new map or even an entire theme. More significant however is the fact that often times MOSS maps are related to external databases whose data may need to be geographically manipulated or spatially represented in MOSS. Since no .AT information exists for much of this data, and since .AT file creation is a lengthy and complicated process, a system was necessary to create new subset maps quickly, It is for this reason that the SLF system was developed.

Solution #1: MOSS' SELECT FROM

MOSS' SELECT command provides the option FROM which works off two ASCII lists created prior to the MOSS session. List #1 contains the names of the maps to be selected from, while list #2 contains the subject search strings which one desires to select. There are several limitations to this approach:

1) since each MOSS session can only access maps in one MOSS project, selections are limited to maps contained in one MOSS project,
2) the resulting selections are represented as active IDs, not new maps
3) there is no easy way to determine which maps and/or themes contained in the selection lists were not selected.
4) MOSS allows only 40 active IDs at one time, making more than 40 selection maps impossible

Solution #2: The SLF System

In an effort to accommodate OSO's on-going geographical analytic needs, a system was developed which could overcome the above limitations. It is built around the MOSS SELECT FROM command, but uses *Oracle* RDBMS and compiled CPL to drive the process as illustrated in Figure 1 below. The program is broken into four processing sections. The first section prompts for and verifies user inputs, section 2 reads the SLF input file and builds the SELECT FROM file sets using *Oracle*, section 3 calls MOSS' SELECT FROM command, and section 4 performs post QC processing and subject renames if requested.

(**Note**: This first release of SLF is tailored to the geographic environment within which OSO operates. Maps come in two major coverages, the first being "township", the second being "district".)

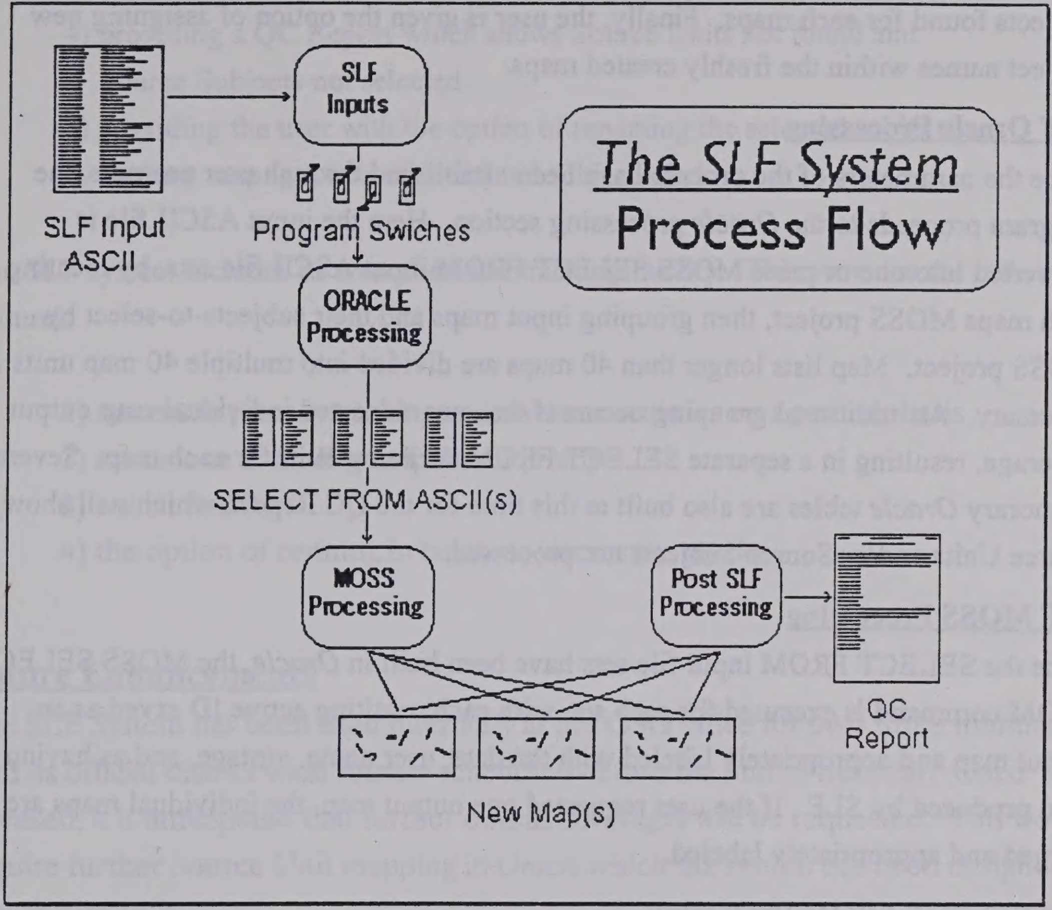
SLF Inputs
SLF Input ASCII
Program Swiches
The SLF System Process Flow
ORACLE Processing
SELECT FROM ASCII(s)
MOSS Processing
Post SLF Processing
QC Report
New Map(s)

Figure #1: SLF Process Flow

SLF Inputs

The SLF program is driven by a user-created ASCII file, which can be created by hand, or generated from a PC or mainframe based database such as *Microstorms* or *Oracle*. This file contains two columns, the first contains SOURCE UNITS (either District or township map names), the second SOURCE SUBJECTS (subject search strings), which are to be selected. The SOURCE UNITS may span multiple MOSS projects and be of either township or district coverage.

Program prompts include a prompt for the name of the SOURCE THEME which will be appended to the map names in this file to form the physical MOSS map names from which the selection will take place. The program also asks the user whether he wants the program to relate map IDs to its appropriate MOSS project or have the program search for maps within one specific MOSS project. The user is also prompted for the unit of coverage for the output map, allowing the option of creating either one map containing all the subjects found in the individual maps, or separate maps which contain only those subjects found for each maps. Finally, the user is given the option of assigning new subject names within the freshly created maps.

SLF Oracle Processing

Once the parameters of the process have been established through user prompts, the program proceeds to the *Oracle* processing section. Here the input ASCII file is converted into one or more MOSS SELECT FROM input ASCII file sets, by locating each maps MOSS project, then grouping input maps and their subjects-to-select by MOSS project. Map lists longer than 40 maps are divided into multiple 40 map units if necessary. An additional grouping occurs if the user requested individual map output coverage, resulting in a separate SELECT FROM set being built for each map. Several temporary *Oracle* tables are also built at this time for the QC Report, which will show Source Units and/or Source Subjects not processed.

SLF MOSS Processing

Once the SELECT FROM input file sets have been built in *Oracle*, the MOSS SELECT FROM command is executed for each set, with each resulting active ID saved as an output map and appropriately labeled with the date, user name, vintage, and as having been produced by SLF. If the user requested one output map, the individual maps are merged and appropriately labeled.

Post SELECT-FROM Processing

After all SELECT FROM sets have been processed, each new output map's resulting subjects are compared against the subject list kept in *Oracle* for that map in order to verify the selections. Any missing subjects are listed in the QC report. Once this step is complete, the subject names are changed if the user so desired.

Why Use SLF?

As outlined above, the SLF System enhances MOSS SELECT FROM by:

1) allowing the user the option of creating either individual maps, or merged maps
2) automatically mapping townships to the appropriate MOSS project, with the option of overriding to one specific project
3) overcoming the 40 active ID limit by breaking processing into acceptable units

4) providing a QC Report which shows Source Units not found and Source Subjects not selected
5) providing the user with the option of renaming the selected subjects on the new map to a new user defined subject label

The SLF system includes its own shell and tracking facility. This provides the following features:

1) automatic process tracking and run-time statistics on a per user basis
2) standalone or on-line help for all prompts
3) a shell facility
4) the option of running in batch or interactive mode

Future Enhancements

The SLF System has been used internally at the OSO office for over three months, with its official district wide release scheduled before the end of this year. Once released, it is anticipated that further output coverages will be requested. This would require further Source Unit mapping in *Oracle* which the system has been designed to absorb elegantly.

Portability

Since the SLF system is written in CPL and *Oracle* SQL, it is limited to *Prime* environments running MOSS and *Oracle*. Equally significant is the fact that the first version of this System was tailored specifically for OSO purposes, meaning that a trivial port to another machine is not realistic. Installation in another environment would require analysis of both the users MOSS map storage configuration as well as his/her mapping needs. As with future enhancements, the SLF System has been designed with this in mind, keeping modifications to a minimum

Acknowledgements

SLF Requirements: Arthur Miller, IDI
SLF *Oracle* Design and Code: Terence Locke, IDI
SLF Driver, MOSS Processing Design and Code: Markus Mattwandel, IDI

WHAT CAN ONE DO WITH AN ESRI PLOT FILE?

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ABSTRACT

In Oregon, BLM augments GISPLOT with a custom plot driver called MOSSPLT. This driver adds several capabilities to the way we create finished map products. These include added support for Calcomp Electrostatic Plotters and the ability to translate ADS. MOSS/MAPS, and COS plot files to AutoCAD DXF format.

MOSSPLT supports on-line plotting to Calcomp Electrostatic Plotters connected to a local PRIME Computer via high speed parallel communications or via serial lines. This implementation provides transparent access to remote plotters over PRIMENET, multiple copy options, rescaling and rotation options, and personal pen definition files. We also provide an elaborate plot queue management system which includes plot banners, log files of plotting activity, and the ability to prioritize plots in the plot queue.

MOSSPLT can also be used to translate an ESRI generic plot file produced by ADS, MOSS/MAPS, or COS into an AutoCAD DXF file. From there, this file can be taken into AutoCAD or hundreds of other commercial programs which read the DXF file format. This gives us limited ability to edit our plots, and it gives us the ability to output GIS products on a wide variety of plotters and printer plotters.

Editor's Note: The presenter may forward proceeding related materials before this talk is given. These materials were unavailable at the time of publication for these proceedings.

AN OVERVIEW OF THE VECTOR PRODUCT FORMAT (VPF)

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Washington, D.C.

ABSTRACT

Vector Product Format (VPF) is a generic geographic data model designed to be used with any digital geographic data in vector format that can be represented using nodes, edges, or faces. VPF is based upon the georelational model, combinatorial topology, and set theory.

VPF is designed to provide flexibility in encoding, directly accessing, and modeling digital geographic databases for a variety of applications on different computer systems. VPF characteristics include the following items: Sheetless database support; Neutral format; Attribute support; Data dictionary; Text and metadata support; Index file support; Direct use; Flexible, general-purpose schema; Data quality; Feature definitions; and Translatability.

Re: Interim Military Standard Vector Product Format (MIL-STD-600006. Contract No: DMA600-89-C-0023), DMA Systems Center, Fairfax, VA 22031-2137) from the Digital Chart of the World Project.

Note: Editor's addition in leu of the presenter's abstract. The presenter may forward proceeding related materials before this talk is given. The abstract was unavailable at the time of publication.

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Improving ADS/MOSS Through VPF

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ABSTRACT

The Draft Project Charter for the GIS Improvement - AIM Project, calls for partial database conversion from the existing MOSS database to the Vector Product Format (VPF). The reason for this conversion is specifically to fix the MOSS commands OVERLAY, MERGE/DISSOLVE, and BUFFER. The conversion to the VPF database should be transparent to the user.

A case can be made to expand beyond the Draft AIM Project Charter and carry the conversion to VPF throughout the entire existing ADS/MOSS/MAPS/COS GIS package. The functional enhancements available to the existing GIS are limited by the current database structures, which prevent the separate parts of the system from sharing information easily or completely. Converting the separate databases to a single database format - VPF - will overcome this obstacle and allow a number of improvements to eventually be realized. Some expected improvements will be saved disk space, streamlined operations for trainers, users and programmers, and creation and manipulation of a seamless database.

THE CURRENT OBJECTIVE

Under the scope of work of the Draft Project Charter for the Geographic Information System (GIS) Improvement - AIM Project, VPF will be used to help correct long standing problems with a few of the MOSS commands. VPF is the acronym for Vector Product Format, a generic geographic data model developed for the Defense Mapping Agency's Digital Chart of the World Project. It was released as a draft Military Standard dated March 1991 by the Department of Defense.

It has been known since roughly 1982 that the MOSS commands OVERLAY, MERGE/DISSOLVE, and BUFFER do not always give correct results. For approximately the last two years, it has been recognized that robust algorithms for these functions could most easily be guaranteed if the MOSS data were not polygonally based. This explains the Draft AIM Project Charter objective to "Replace the polygon based Overlay, Merge/Dissolve, and Buffer functions with arc/node algorithms to improve the quality and reliability of analysis and output products."

not confirmed, we anticipate that this side effect can be minimized by changing process priorities.

The prototype is now in the testing and evaluation stages but has already been proven to give better results than the current OVERLAY function. All items in the current Draft GIS Improvement AIM Project Charter are expected to be completed within two years of charter approval. As working prototypes of the OVERLAY command and the MOSS-to-VPF-to-MOSS shell already exist, this particular objective of the Draft Charter can be expected to be completed before that deadline.

FURTHERING THE CONVERSION

The scope of the Draft AIM Project Charter limits the conversion to VPF for the purposes of fixing specific MOSS commands. However, the Draft Charter also added the requirement to optionally save the intermediate VPF structure as permanent files. This can lead to the speculation that once the Draft Charter objective is achieved, complete conversion of the MOSS database format to VPF will follow.

A Drawback to Complete Conversion

The only significant drawback to a unilateral action by the BLM to convert the MOSS database completely, is that such an action would deviate from the Memorandum of Understanding (MOU) between the BLM, U. S. Forest Service, U. S. Fish and Wildlife Service, and the Bureau of Reclamation. The MOU is the basis for the Draft AIM Project Charter objective to "Establish an interagency version of MOSS/MAPS/COS." Unless or until the USFS, USFWS, and the BOR also convert their MOSS databases to VPF, fulfilling this objective would be implausible.

The Problems with an Incomplete Conversion

On the other hand, there are several drawbacks to not converting or only partially converting to VPF.

By not converting at all, it can be assumed that the MOSS commands OVERLAY, MERGE/DISSOLVE, and BUFFER will never work with 100% reliability. This "do nothing" option has wisely been abandoned by the BLM.

As discussed previously, the prototype MOSS-to-VPF-to-MOSS shell is time and memory intensive. Though we expect finessing the prototype may decrease the impact, the problem will not disappear, and this makes unpalatable the concept of running under the MOSS-to-VPF-to-MOSS shell for every invocation of OVERLAY (or MERGE/DISSOLVE, or BUFFER) for the same data. To avoid this, the VPF structured data could be saved to disk, but this would impact disk storage space because both the VPF version and the MOSS version of the data would have to be stored. Granted, even with a complete conversion, both these effects - increased run time and impacted disk storage space - would be present during a phase-in period; but to stagnate at this stage would soon become intolerable.

THE DATABASE

Around the time that the Draft AIM Project Charter was being written, the Service Center became aware of the DMA project and the VPF database structure.

VPF is an arc/node database structure where, by definition, digital geographic information is stored in its most primitive components (nodes, edges, and faces); and it defines a way to represent the topologic interrelationship of these data primitives. Recognizing that textual information and other visually distinctive keys (such as symbols, and line and shading styles), are necessary to cartographic representations, VPF allows text to be treated as a data primitive, and also provides a mechanism for keying to attribute information.

VPF was seen to be an emerging public domain standard that appeared to have all the necessary elements for our applications. As it was a public domain product, it did not conflict with the Draft Charter position disallowing mandatory acquisition of commercial products for this task. As a standard, we could expect continued support. For both these reasons, we foresee other governmental agencies adopting VPF as a platform and thereby increasing the ease of future interagency data sharing. Also, VPF was designed to work easily within a relational database structure and would not impede progress of the MOSS/ORACLE bridge. In short, VPF met all the requirements.

In several respects VPF is not conceptually very different from the database structure already being used in ADS. However, there are enough differences between the ADS database structure and a true arc/node structure to have required revising the ADS database for this task. It was decided that adopting VPF would be more beneficial in the long run than adapting the ADS database, so VPF was named in the Draft AIM Project Charter as the arc/node structure of choice.

THE PROTOTYPE CONVERSION-SHELL/OVERLAY

The current approach to implementing the Draft Charter objective is to convert a MOSS data file "on the fly" to VPF then, while holding the VPF structure in memory, perform the requested function and convert the results back to the existing MOSS format for output. The immediate benefits to the user of this conversion will be improved reliability of OVERLAY, MERGE/DISSOLVE, and BUFFER. The conversion to VPF itself should be virtually transparent to the user. The term 'virtually' is used because an increase in run time can be expected during at least the phase-in period.

Working under the current authorization to repair existing problems in MOSS, and to assess the feasibility of the objective in the Draft Charter, BLM and TGS Technology programmers have already developed a new OVERLAY program working under a prototype MOSS-to-VPF-to-MOSS shell.

Preliminary tests show that, as one would expect, the run time is significantly increased. This shell is highly memory intensive and has the notable side effect of dramatically slowing the completion of disk I/O intensive processes which are trying to run at the same time. Though

The Case for Completion in MOSS

The benefits of complete conversion of the MOSS database to the VPF structure go beyond avoidance of the above discussed negative impacts of partial conversion.

The VPF structure makes more efficient use of disk space than does the current MOSS database structure, i.e., VPF can store the same data in less space. This is due primarily to two factors. By definition in an arc/node structure, each line (edge) is stored only once and referenced by the features which use it; whereas in a polygonal structure, each line is stored again for each feature of which it is a part. For a MOSS map with no null areas, this cuts storage space needed for coordinates almost in half. The second factor has to do with the way MOSS stores attribute data.
Currently, regardless of the number of polygons in MOSS which have an attribute, MOSS creates an attribute file of the same size, thereby usually wasting disk space.

Another feature of VPF will, when implemented, allow further optimization of disk space. VPF has a mechanism for recognizing and addressing data features that continue across logical map boundaries; in other words, VPF will allow the creation of seamless databases ('tiling' in VPF terminology). Tiled data will allow adjacent maps to be analyzed as though they are one map. Because data from these mapfiles will not have to be copied to yet another mapfile for analysis or display, disk space will be saved, and some problems associated with map size limitations will be avoided. Tiling will also allow fuller utilization of the multiple project concept (just recently introduced to ADS and MOSS) and help avoid PRIME directory storage limitations.

Incidentally, the VPF structure can easily accommodate the concept of multiple attributes, a desirable feature for MOSS users and part of the impetus for the MOSS/ORACLE bridge.

Carrying Through to ADS

Additional improvements to the GIS would be realized if the conversion to VPF was carried to ADS. First, and most obvious, having a single database structure for the entire system will result in even more efficient use of disk storage space, i.e., only one copy of the data should be needed. An important by-product of this would be the elimination of ADS-to-MOSS and MOSS-to-ADS conversions and the possible distortion or loss of data now inherent in these processes.

As mentioned before, the VPF and ADS database structures while technically different are conceptually the same, so the biggest change to ADS users would be the conversion from map inches to real world coordinates. Although moving from map inches to real world coordinates will increase the storage space required for any single map, this is easily offset by the fact that only one copy of the data should be necessary.

There are several tangible advantages of real world coordinates over map inch coordinates. As projecting or reprojecting coordinate information will not necessarily be involved, implementation of tiling and other map to map operations will be more straight forward and less error prone. Editing and analysis will be easier for the user as user input tolerances would not be dependant on map scale. An important feature is that the accuracy and precision of non-digitized real world coordinates will not be affected upon input to the system. (The word "non-digitized" is emphasized as it must be remembered that the accuracy and precision of digitized information is dependant upon the scale of the map, the digitizing tablet, and the digitizer. No accuracy or precision is gained or lost by storing digitized data in real world coordinates.)

Some less obvious improvements that would become possible are the access of editing tools while "in" MOSS and analysis tools while "in" ADS. In short, by having a single database structure, the barriers of the GIS can be crossed. ADS, MOSS, MAPS and COS can be presented to the user as a single integrated system, with the processes of data input, editing, analysis, and display becoming cyclical rather than linear.

Having a single system working from a single database structure will allow the elimination of duplicate commands (or functions) and programs. This will lead to easier cross-training of users, support personnel, and programmers and allow both field and Service Center operations to be streamlined.

Another software package, a PC-based aviation hazard information and graphic display system, is being developed by TGS for the Boise Interagency Fire Center (BIFC) using the VPF structure. With ADS/MOSS/MAPS/COS and this new software all using VPF, broader benefits may be realized from resources expended on fixing or enhancing any of these separate systems.

Incidental Benefits

Maintaining existing capabilities and virtual transparency to the user are goals of even a partial conversion to the VPF structure. To accomplish this, a command shell will need to be constructed. This requires reanalysis and possibly reorganization of the existing command structure. This work will be a useful first step towards realizing another Draft AIM Project Charter objective, to "Develop a graphic user interface which will save time in training and facilitate increased use of the system." Reportedly, prototype software for converting from the new Spatial Data Transfer Standard to VPF has already been written; therefore, moving to a single VPF database structure for the entire GIS will fulfill the Draft Charter objective to "Improve data exchange and data management capabilities".

CONCLUSION

We are not representing VPF as a panacea for all the present ills in ADS/MOSS; after all, VPF is just a database structure, not a GIS package. Programs will still need to be written to address changing or unique user requirements, and bugs will be uncovered. However, we recognize that certain existing problems and needed enhancements can only be addressed realistically by adopting a single arc/node structure throughout the entire system. We encourage your support for a complete database conversion, perhaps expanding the scope of the Draft AIM Project Charter or initiating a follow-on effort toward this end.

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SESSION 7: GIS OPEN FORUM

THURSDAY, DECEMBER 12, 1:00 PM - 3:15 PM

SESSION CHAIRPERSON:

Kathie Jewell

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OPEN DIALOGUE FOR ADS DIRECTION

MODERATED BY

Wendy Tetley Bullock
GIS Software Support Section
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BLM Service Center
P.O. Box 25047
Denver, Colorado 80225-0047

Personal Notes from the Open Dialogue.

Bugs
1260
como file
data sets to reproduce problem

Enhancements
More requirements in great detail

Personal Notes from the Open Dialogue.

OPEN DIALOGUE FOR MOSS/MAPS DIRECTION

MODERATED BY

Jim Blancett
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Personal Notes from the Open Dialogue.

1. digitize all the lines & symbols
2. Go into Edit and say you want to add labels.
3. answer questions font, size, slant etc all the same for all of them

problem with intersect and the subjects and the space problems come later when go into other intersects stuff is off Problems in COS because the subject in now space attribute rather than just attribute

Selecting a map, items by cursor. Does not pick small items very well. The exact cursor location is not where it is.

Rasterizing correctly. Does not recognize the • as something unique.

Personal Notes from the Open Dialogue.

SESSIONS 8 & 9:

INTRA-AGENCY COORDINATION MEETINGS

THURSDAY, DECEMBER 12, 3:00 PM - 5:00 PM

AND

FRIDAY, DECEMBER 13, 8:30 AM - 11:30 AM

To be Announced and Conducted by Respective Agencies

Personal Notes from the Intra-Agency Coordination Meetings.

Personal Notes from the Intra-Agency Coordination Meetings.

Personal Notes from the Intra-Agency Coordination Meetings.

Personal Notes from the Intra-Agency Coordination Meetings.

Personal Notes from the Intra-Agency Coordination Meetings.

POSTER SESSION

TUESDAY THROUGH FRIDAY, DECEMBER 10 - 12, 1991

All Poster Session Abstracts Received for Publication

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Enhanced capabilities of the new Emu-Tek 4200 Tektronix emulation software for GIS operations on a Personal Computer

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ABSTRACT

The Personal Computer (PC) is quickly replacing the traditional "Dumb" terminal as the preferred user platform for accessing Geographic Information System (GIS) and other software programs currently running on Prime mini-computers in the Bureau of Land Management. The increased speed and capabilities of the modern PC, significant cost reductions in recent years, and the ability to operate other software programs on an independent central processing unit (CPU) is making the PC a more cost-effective choice.

Emu-Tek 4200 is a software package that will configure a PC to emulate a Tektronix 4200 series graphics terminal for connecting to a host computer and performing as a tektronix terminal. Some of the major features and advantages of Emu-Tek 4200 are listed below:

Network support	Allows Emu-Tek to be operated from a Local Area Network and access peripherals
VGA & SVGA	Uses VESA compliant graphics drivers and allows up to 1024 X 768 resolutions
Two Terminal Mode	Will send color graphics to one monitor while sending text to another

Kermit support	Used to upload and download files with the host computer using Kermit protocol
"Hot-key" to DOS	Can "shell out" to DOS and execute DOS or network functions
Keyboard Release	Releases the keyboard to execute other software control sequences like "Grab"
Zoom and Pan	Faster redisplay with Pan and Zoom functions from captured graphics files
Variable Display	Display, erase, and print graphics or text independently

GIS ACTIVITIES IN WESTERN OREGON

POSTER SESSION

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ABSTRACT

Poster session will display various cartographic products developed from MAPS data, using the COS software, during the Resource Management Plan process. Planning and alternative maps displaying what is "out of base" for timber harvest and tables/graphs showing the hierarchy of "out of base" features, along with acreage calculations from ORACLE will be shown.

Poster will highlight where CPL's were used to automate COS procedures for map production. A description of the ORACLE/Forest Operations Inventory (FOI) linkage will be outlined, showing data flows between MOSS/MAPS applications and the PC database used daily for forest inventory.

Wildlife habitat products produced for various agencies and private research studies will also be displayed and discussed. Explanations of CPL's used to create plots and queries used to obtain site specific information from various databases will be shown. Variations of the Spotted Owl recovery plan(s) and analysis encompassed with each new release will be presented on the poster.

UPLAND GAME MANAGEMENT IN THE NICOLET NATIONAL FOREST

POSTER SESSION

Tony Rinaldi
Wildlife Biologist
Nicolet National Forest

Bob Howe
University of Wisconsin
Green Bay, Wisconsin

Jan Zarling
GIS Coordinator
Nicolet National Forest

ABSTRACT

The Nicolet National Forest breeding bird survey has five years of data, over 300 survey sites and 4000 observations. This is a cooperative survey between the Nicolet National Forest and Northeastern Wisconsin Chapter of the Audubon Society. The survey takes place over two days each spring at permanent survey sites within the boundary of the Nicolet National Forest.

The poster demonstrates use of the Nicolet National Forest's GIS (MOSS) as a tool in identifying bird survey sites, analysis of bird distribution, and monitoring breeding bird populations on the Forest. The linkage between MOSS, our bird survey database (ORACLE), and our vegetation database (ORACLE) is demonstrated.

PROGRESS ON DEVELOPMENT OF A GIS TOOLBOX FOR COMPREHENSIVE WATERSHED MANAGEMENT PLANNING

by

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Development of comprehensive watershed management plans often requires modeling of surface hydrologic processes on the watershed. Models exist to provide information on sheet and rill erosion, sediment yield into streams and channels, gully and channel erosion, and sediment transport based on data about soils, vegetation, topography, geology, hydrology and climate in the area of study. These models are often applied to large portions of watersheds using gross estimations of the value of their parameters. Interfacing them with the data processing capabilities of Geographic Information Systems permits analysis of large areas more quickly and with finer detail based on information contained in digital data layers. Sets of maps and tabular outputs can be generated to describe existing conditions as well as potential outcomes of various management alternatives, pemitting better informed decisionmaking.

The extent of present efforts on development of a GIS tool box for modeling of surface hydrologic processes for a watershed includes so far methods for interfacing the Revised (RUSLE) and the Modified Universal Soil Loss Equations (MUSLE) to provide information on soil detachment due to sheet and rill soil erosion and on sediment yield for particular storm events. Future efforts will involve looking into the possibilities of GIS modeling for channel erosion, mass wasting, and sediment routing. Work done in this area by the Forest Service and the Geological Survey will provide useful basis for futher development efforts. The goal is to provide a complete set of advanced GIS modeling techniques that will permit more extensive use of BLM's current spatial processing capabilities to aid in the Bureau's mission of multi-purpose, ecologically sound management of natural resources on public lands.

BLM GIS Activity, State of California, 1991

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Poster Session

ABSTRACT

GIS activity growth was strong again in 1991. User proficiency levels are higher in most offices. At the State Office (CASO), Mapping Sciences (MS) has increased both its expertise and throughput. MS has ambitious plans for '92 including addition of personnel and equipment. IRM has continued its hardware, software and training support. Increasingly, IRM is turning project-oriented tasks over to MS; IRM has already involved MS in the training and support of ADS users.

Eleven of 15 Resource Areas (RAs) have had some GIS activity in 1991. Activity ranges from simple first-time equipment acquisitions to complex GIS supported projects. Three of 4 District Offices (DOs) have had significant GIS activity in support of RAs within their District and in DO sponsored projects.

Several events had state-wide implications. The CASO acquired a PRIME 6650. The old PRIME 9955 MOD II was sent to the Desert DO. The Desert DO, in Riverside, has moved to a new office which has a large dedicated computer room. There are plans to upgrade the state-wide data communications network allowing all offices to communicate at 9600 baud. Many offices are now at 2400 baud. The plan includes networking all PRIMEs within the state and should be completed by April, 1992. MS has acquired a Calcomp 68000 electrostatic plotter to be fully functional in January, 1992. MS has plans to acquire Line Trace Plus. This will have significant applications towards automation of the State's Wilderness mapping program, and enhance the availability of 7.5' DEMs within the State.

Many significant GIS supported projects were worked on in the last year. Refer to the Poster Session display for a thorough presentation. Listed here are a few of the larger projects: the High Rock - Black Rock project on which the Surprise RA is working in cooperation with the Winemuca DO of Nevada, coordinated out of the Nevada SO; the American River NRA Study out of the Folsom RA (this study also included an interesting ORACLE-supported study of written public meeting comments); an excellent RMP document and BLM CA's first inter-agency GIS cooperative agreement out of the Bishop RA; collection of Flat Tailed Lizard data with GPS for GIS use by the El Centro RA; the acquisition of BLM CA's first genuine graphic work station by the Eagle Lake RA; completion of the South Coast RMP by the Palm Springs RA; support of a large Lands Adjudication project by MS & IRM, CASO; development of a concise, one-page Digitizing Overlay Preparation Guide by MS & IRM, CASO; continuing work on the Desert Tortoise Plan and Wilderness Study Areas by many people in many offices throughout the State.

IRM, CASO, hopes to initiate a State-wide PRIME/GIS users working group in '92. It is hoped to meet semi-annually to coordinate activities and standards, as well as to share significant procedural information.

THE IDAHO STATE OFFICE

DLG TO ADS PROCESS

(ADDENDUM PAPER TO PROCEEDINGS)

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ABSTRACT

The Idaho State Office has been incorporating DLGO files into our state-wide database. Using the DLG to ADS translation program alone was not sufficient to encode ADS files properly. Interactive processing to further translate the ADS files has proven very time consuming and there was a need for a more efficient translation process. The process developed incorporated the use of CPL's for several ADS routines. It converts DLG Boundary, Hydrography, Pipe and Transmission Line, Road and Trail, Railroad and Man Made Feature files created for our Burley District into final ADS base map files. Using the CPL's for translation proved to shorten production times for base map creation considerably.

CHICAGO AERIAL SURVEY 1990 DLG CONTRACT
TRANSLATION PROCEDURES TO ADS FORMAT
November 12, 1991

1. Copy most updated files into CAS90 from the QC directories. An example of a QC directory is <ID9424>ADSDATA>CAS90>ARBONQC. The naming convention of the new files would be:

   Boundaries: First 4 to 7 letters of quad sheet + BOU
   e.g. ARBOBOU, IRESPBOU

   Hydrography: First 4 TO 7 quad letters + HYDRO
   e.g. ARBOHYDRO

   Pipe and Transmission Lines: First 4 TO 7 quad letters + PITR
   e.g. ARBOPITR, DECKPKPITR,SHECKPKPITR

   Roads and Trails: First 4 TO 7 quad letters + RDTR
   e.g. ARBORDTR, DECKPKRDTR

   Railroads: First 4 TO 7 quad letters + RR
   e.g. ARBORR, DANIRR

   Man made features: First 4 TO 7 quad letters + MAN
   e.g. ARBOMAN

   Use CASCOPY.CPL in <ID9424>ADSDATA>CAS90 to copy these. This macro may need to be modified. Before using or modifying any macros listed, move them to your own work area.

2. Use DLGO to ADS (ADS option 10) to translate DLGO files to ADS files.

   Give the ADS project name CAS90

   Give the DLGO file name e.g. ARBOBOU

   Give the ADS file name. Presently, this has to be a unique map name for the DLGO to ADS translator to work. File naming conventions follow.

   Quad code + first three letters of the menu name.For example:

   Hydro: ARBOHYDRO goes to D542112 This map will be the map with the control points

   Roads and Trails: ARBORDTR goes to D542112RDTR

   Pipe and Transmission lines: ARBOPITR goes to D542112PITR

   Railroads: ARBORR goes to D542112RR

   Boundaries: ARBOBOU goes to D542112BOU

   Man made features: ARBOMAN goes to D542112MAN

   Keep coded line labels and bring the features into the TOTALMENU theme in ADS. CASDLG2ADS.CPL is a macro that will accomplish this DLG to ADS process. It is in <ID9430>JMORK>ADS.TEST>REV8. Unless otherwise noted, all macrmentioned in this paper will be found in this directory. Again, move macros to your own work area before using them.

3. Resequence .A, .L, and .S files using ADS RESEQUENCE. Three macros will helpyoaccomplishthis. They are: CASRESQA.CPL for attributes, CASRESQL.CPL for lines, and CASRESQS.CPL for symbols.

4. Use ADS EDIT's AUDIT to identify DLG major and minor codes. Use ADS EDIT's MODIFY command to place DLG line and symbol labels and area attributes into ADS data categories. See appendix A to F to find ADS equivalents to DLG attributes/labels. These equivalents were developed from the U.S. Geological Survey's DLG User's Guide, Appendix D. To modify DLG attributes and labels, use AUDIT to identify the DLG strings to change (change the longest strings first). Then use AUDIT to identify the individual records containing this label/attribute. Then give the command: **MOD** (data type),(range of records),R. An example would be **MOD 2,1,3,6,7-24,R** this would replace the labels for lines 1,3,6,7 to 24. ADS will prompt you for the old label, then the new label and then replace it. Note on GLAKES attributes, the original DLG attributes have four leading blanks so place these in your string before modifying the area attributes. For example a label of 50___412 should be listed as ____050___0412 and replaced with RESERVOIR. Macros will be developed for this. They will be REPLACE(3 letter DLG theme)S.CPL for symbols, REPLACE(3 letter data theme)L.CPL for lines and REPLACE(3 letter data theme)A.CPL for attributes. These macros will be:

    REPLACEHYDA.CPL
    REPLACEHYDL.CPL
    REPLACEHYDS.CPL
    REPLACERDTL.CPL
    REPLACEPITL.CPL
    REPLACEMANS.CPL
    REPLACEMANL.CPL

    The boundaries file should be looked at and manually modified.

    The replaceL macros will convert DLG codes to labels pointing to BLM line types, for example, a DLG label of 50 412 in a hydro file would become GSL2 indicating GSTREAMS line type 2. A label of 50 412 50 610 would become GSL1 Indicating GSTREAMS line type 1. The replaceA macros will convert DLG area codes to BLM area attributes. For example, 50 101 in a hydro file would be changed to RESERVOIR and 50 119 would be changed to POND. The replaceS macros will convert DLG symbol labels to BLM symbol labels. For example, symbol 50 300 would be changed to a GSSYB2 because it is a spring which would have no label and symbol 50 302 would be changed to GSSYB1WELL because it is a well and is to be labeled. These macros are in <ID9430>JMORK>ADS.TEST>REV8. They may need to be revised to accommodate a wide variety of DLG attributes/labels.

5. Use ADS EDIT's DUPLICATE to duplicate the TOTALMENU theme items in each map to their proper ADS themes. Themes that may be duplicated to are:

DLG THEME	POSSIBLE ADS MENUS
HYDRO..........................	GSTREAMS GLAKES GMISCULT
ROADS AND TRAILS.............	GTRANS GRAILROADS
RAILROADS....................	GRAILROADS
PIPE & TRANSMISSION LINES....	GMISCULT
BOUNDARIES...................	GPLANDLINES CARTOBOUNDS BOUNDARIES
MAN MADE FEATURES...........	IM.PROJECTS

Use DUPLICATE for lines, so the line labels will not be transferred into the new menus. Proper BLM line labels will need to be added later.

Use the DUPLICATES (DUS) command for the already converted area attributes. To use the DUPLICATES command, first select the desired area attributes in the TOTALMENU theme using ADS EDIT's SELECT. Then use the DUPLICATES command. An example would be to select all the area attributes using the SELECT WINDOW AT option on your whole map. Then give the DUS command. All of the area attributes you selected will then be placed into the theme you specify.

Use DUPLICATES for the symbols files. Follow the same general procedure as you did to transfer area attributes to a new theme.

6. Check to be sure all DLG items are accounted for and are in the proper BLM theme.

7. Add new labels and attributes.

8. When all DLG information has been placed into appropriate BLM themes, resequence may need to be run to delete undesired data that has already been marked for deletion. Use RESEQUENCE or run the following macros:

CASRESQA2.CPL for BLM area attribute files
CASRESQL2.CPL for BLM line files
CASRESQS2.CPL for BLM symbol files

These macros prompt you for the ADS quad code e.g. D542112.

9. When all of the DLG information has been placed into the appropriate BLM themes, ADS EDIT's MERGE is to be run. The control map is the GSTREAMS/GLAKES map and will be entered first. This map is already in the standard ADS naming convention e.g. D542112, C542112. PHMERG1.CPL has been designed for merging one theme at a time and can be run as a phantom process. Arguments are:

   PROJECT
   CONTROL MAP
   MAP2
   THEME1
   DATA TYPES

   where PROJECT is the ADS project e.g. CAS90
   CONTROL MAP is the GSTREAMS/GLAKES map e.g. C542112
   MAP2 is the map being merged in e.g. D542112BOU or D542112PITR
   THEME1 is the theme being merged in e.g. BOUNDARIES or GTRANS
   datatypes include polygons,labels, attributes or symbols or a combination of these. Give the macro data types that actually exist. e.g. PS or LAS. An example would be: PHMERG1.CPL CAS90,D542112,D542112BOU,BOUNDARIES,L

10. Compare the number of items in the new files to the items in the old files to make sure nothing was lost during ADS MERGE. Three macros can be revised to do this. They are: CASCOMPAREA.CPL for attribute files, CASCOMPAREL.CPL for line files, and CASCOMPARES.CPL for symbol files. These can be run without user input but will need to be revised so they can be run from your user area. Revise the line that attaches you to <ID9430>JMORK>ADS.TEST>REV8 at the end of the macro.

    After these are run, print to the screen COMPAREA.COMO, COMPARES.COMO and COMPAREL.COMO to verify file information.

11. If there are items missing from the control quad, graphically compare old and new files to find the missing items. Duplicate the missing items into a new theme name (e.g. LANDLINES) and remerge this information into the master ADS map.

12. Once the maps have been successfully merged, go into each theme and mass modify the line label and area attribute fonts, pen color and heights. This should only have to be done to GSTREAMS, GLAKES, GMISCULT and BOUNDARIES. An example would be MODIFY 2,1-500 F,P,HT where F=1,P=1, and HT=.07.

    Modify symbol widths in GSTREAMS, GLAKES, GMISCULT, GTRANS and IM.PROJECTS. An example would be MODIFY 1,1-35 W.

    You can use MODFONT.CPL to modify font, pen, and height and line and symbol widths. To use MODFONT.CPL, themes within the .MENUS file need to be in the following order:

    2 GSTREAMS
    3 GLAKES
    4 GMISCULT
    5 GTRANS
    6 GPLANDLINES
    7 BOUNDARIES
    8 CARTOBOUNDS
    9 IM.PROJECTS

    The argument supplied is the ADS map code e.g. D542112

SYMBOL HEIGHTS

GTRANS

.04 = BRIDGE
.04 = DRAWBRIDGE
.04 = TUNNEL

GLAKES

.09 = LARGE FALLS
.09 = LARGE RAPIDS
.04 = RIVER MILE #

GSTREAMS

.10 = WELL
.10 = SPRING
.10 = SMALL FALLS
.05 = SMALL RAPIDS

GMISCULT

.12 = WINDMILL
.12 = GAGING STATION
.12 = PUMPING STATION
.09 = DAM

GRAILROADS

.04 = BRIDGE, SINGLE-TRACK
.06 = BRIDGE, MULTIPLE-TRACK
.04 = TUNNEL
.04 = DRAWBRIDGE

IM.PROJECTS

.10 = WATER_TANK

13. Edgefit the themes. Use a snap tolerance of .015 and follow the state office edgefit instructions.

14. Run ADS EDIT'S CLOSURE and POLYGON on GLAKES and BOUNDARIES. Use the attribute of BLANK for land areas outside of water polygons.

15. Create and send a QC plot of the merged map themes with fancy lines on. Make one plot with everything on it and one plot with GSTREAMS, GMISCULT, BOUNDARIES and IM.PROJECTS to help distinguish themes from each other.The macro PLOTEM.CPL will make a plot file. You will be prompted for the project name, the map code, the plot name, if you want fancy lines, and the theme numbers. Plot names need to be unique (the macro is not designed to overwrite old plot files).

16. QC and edit the plots.

17. If more lines/attributes/or symbols have been deleted since the last resequence, resequence again. Three macros will help you do this. They are: CASRESQA3.CPL, CASRESQL3.CPL and CASRESQS3.CPL. These macros prompt you for the ADS quad code e.g. C542112.

18. If attribute files were resequenced, ADS ENCLOSE will need to be run. This can be done at any time using the CASENCLOSE.CPL. Arguments are: PROJECT, MAP CODE, AND MENU NUMBER.
    e.g. R CASENCLOSE.CPL CAS90 C642112 3

19. When all data items are accounted for, subtract the TOTALMENU theme from the final maps menu.

20. Move the final ADS maps into <ID9422>ADSDATA>POCATELLO when finished. Use the COPYPOC.CPL macro to do this. You will be prompted for the ADS map code.

21. Archive to tape the original QC'ed DLG files that were named according to item 1 rules. These files should be in the QC directories. Store a printout of these files for future reference. Giving the files identifiable names will help in the future if additional information is needed.

22. When final maps are in the master DIR's and the original DLG's are backed up to tape, delete all the working files from your directory.

APPENDIX A - Hydrography Data Records 1983 and Beyond

Type of Code: Feature Identification
Application: Areas

Major Code	Minor Code	Description	Idaho ADS Theme	Line Type	Line Label	Area/Symbol Attribute
050	0101	Reservoir	GLAKES	5		RESERVOIR
050	0106	Fish Hatchery	GLAKES	3		POND
050	0107	Industrial Water Impoundment	GLAKES	3		WASTE_POND
050	0109	Sewage Disposal Pond	GLAKES	3		WASTE_POND
050	0110	Tailings Pond	GLAKES	3		WASTE_POND
050	0111	Marsh, Swamp, Wetland	GLAKES	4		MARSH
050	0119	Duck Pond	GLAKES	3		POND

Application: Lines

Major Code	Minor Code	Description	Idaho ADS Theme	Line Type	Line Label	Area/Symbol Attribute
050	0200	Shoreline	GLAKES	1,3		RIVER/LAKE
050	0201	Manmade Shoreline	GLAKES	5		RESERVOIR
050	0204	Apparent Limit	GLAKES	10		MARSH

Application: Points

Major Code	Minor Code	Description	Idaho ADS Theme	Line Type	Line Label	Area/Symbol Attribute
050	0300	Spring	GSTREAMS	Symbol	2	
050	0301	Non-flowing Well	GSTREAMS	Symbol	1	DRY_WELL
050	0302	Flowing Well	GSTREAMS	Symbol	1	WELL
050	0305	Windmill	GMISCULT	Symbol	1	WINDMILL

Application: Multiple Element Types

Major Code	Minor Code	Description	Idaho ADS Theme	Line Type	Line Label	Area/Symbol Attribute
050	0400	Rapids	GSTREAMS	Symbol	4	SMALL_RAPIDS
050	0401	Falls	GSTREAMS	Symbol	3	SMALL_FALLS
050	0403	Gaging Station	GMISCULT	Symbol	2	GAGING_STATION
050	0404	Pumping Station	GMISCULT	Symbol	3	PUMPING_STATION
050	0406	Dam or Weir	GMISCULT	Symbol	4	DAM
050	0412	Stream	GSTREAMS	2		
050	0413	Braided Stream	GSTREAMS	2		
050	0414	Ditch or Canal	GSTREAMS	4	DITCH or CANAL	
050	0415	Aqueduct	GSTREAMS	4	AQUEDUCT	
050	0416	Flume	GSTREAMS	4	FLUME	
050	0418	Siphon	GSTREAMS	10	SIPHON	
050	0420	Wash or Ephemeral Drain	GSTREAMS	1		
050	0421	Lake or Pond	GLAKES	3	LAKE	

Type of Code: Descriptive
Application: Multiple Element Types

Major Code	Minor Code	Description	Idaho ADS Theme	Line Type	Line Label	Area/Symbol Attribute
050	0604	Tunnel	GSTREAMS	9	TUNNEL	
050	0605	Right Bank	GLAKES	1		
050	0606	Left Bank	GLAKES	1		
050	0610	Intermittent	GSTREAMS	1,5 or GLAKES 2,4,8		
050	0611	Abandoned	GSTREAMS	9	ABANDONED + (TYPE)	
050	0614	Dry	GLAKES	6		DRY_LAKE
050	0615	Mineral or Hot	GSTREAMS	Symbol 2		HOT_SPRING
050	0618	Earthen Construction	GMISCULT	Symbol 4		EARTHEN_DAM

Type of Code: Parameter
Application: Multiple Element Types

Major Code	Minor Code	Description	Idaho ADS Theme	Line Type	Line Label	Area/Symbol Attribute
055	____	River Mile	GLAKES	Symbol 1		RIVER_MILE_XXX
059	00__	Coincident Feature	GSTREAMS\GLAKES where appropriate			

APPENDIX B - Road and Trail Data Records 1985 and Beyond

Type of Code: Feature Identification
Application: Nodes

Major Code	Minor Code	Description	Idaho ADS Theme	Line Type	Line Label	Area/Symbol Attribute
170	0001	Bridge Abutment	GTRANS	Symbol	1	BRIDGE
170	0002	Tunnel Portal	GTRANS	Symbol	4	TUNNEL
170	0007	Drawbridge	GTRANS	Symbol	2	DRAWBRIDGE

Application: Lines

Major Code	Minor Code	Description	Idaho ADS Theme	Line Type	Line Label	Area/Symbol Attribute
170	0201	Primary, Class 1, Undivided	GTRANS	2		
170	0202	Primary, Class 1 Divided by center line	GTRANS	2		
170	0203	Primary, Class 1, Divided, Lanes Separated	GTRANS	1		
170	0204	Primary, Class 1, One Way, Undivided	GTRANS	2		
170	0205	Secondary, Class 2 Undivided	GTRANS	4		
170	0206	Secondary, Class 2 Divided by center line	GTRANS	4		
0	0207	Secondary, Class 2, Lanes Separated	GTRANS	4		
170	0208	Secondary, Class 2, One Way, Undivided	GTRANS	4		
170	0209	Road or Street, Class 3	GTRANS	5		
170	0210	Class 4	GTRANS	6		
170	0211	Trail, 4WD, Class 5	GTRANS	7	TRAIL or JEEP_TRAIL or PACK_TRAIL	
170	0212	Trail, 4WD, Class 5	GTRANS	7	TRAIL or JEEP_TRAIL or PACK_TRAIL	
170	0213	Footbridge	GTRANS	7	FOOTBRIDGE	
170	0217	Class 3	GTRANS	5		
170	0218	Class 3	GTRANS	5		

Type of Code: Descriptive
Application: Multiple Element Types

Major Code	Minor Code	Description	Idaho ADS Theme	Line Type	Line Label	Area/Symbol Attribute
170	0603	Under Construction, Classification Known	GTRANS	8	ROAD_UNDER_CONSTRUCTION	
170	0604	Under Construction, Classification Unknown	GTRANS	8	ROAD_UNDER_CONSTRUCTION	
170	0605	Old RR Grade	GRAILROADS	2	ABANDONED_(SINGLE)	
179	00--	Coincident Feature	GTRANS	Where	appropriate	

APPENDIX C - Transportation, Railroad Data Records 1985 and Beyond

Type of Code: Feature Identification
Application: Nodes

Major Code	Minor Code	Description	Idaho ADS Theme	Line Type	Line Label	Area/Symbol Attribute
180	0001	Bridge Abutment	GRAILROADS	Symbol	1	BRIDGE
180	0002	Tunnel Portal	GRAILROADS	Symbol	3	TUNNEL
180	0007	Drawbridge	GRAILROADS	Symbol	4	DRAWBRIDGE

Application: Lines

Major Code	Minor Code	Description	Idaho ADS Theme	Line Type	Line Label	Area/Symbol Attribute
180	0201	Railroad	GRAILROADS	1		
180	0202	Railroad in Street	GRAILROADS	1		

Type of Code: Descriptive
Application: Multiple Element Types

Major Code	Minor Code	Description	Idaho ADS Theme	Line Type	Line Label	Area/Symbol Attribute
180	0603	Abandoned	GRAILROADS	2	ABANDONED_(SINGLE)	
180	0604	Dismantled	GRAILROADS	2	ABANDONED_(SINGLE)	
180	0608	Under Construction	GRAILROADS	3	UNDER_CONSTRUCTION_(SINGLE)	

Type of Code: Parameter
Application: Multiple Element Types

Major Code	Minor Code	Description	Idaho ADS Theme	Line Type	Line Label	Area/Symbol Attribute
181	___	Number of Tracks	GRAILROADS	4 to 6		(Individual Basis)

APPENDIX D - Transportation, Pipelines, Transmission Lines and Miscellaneous Data Records 1985 and Beyond

Type of Code: Feature Identification
Application: Lines

Major Code	Minor Code	Description	Idaho ADS Theme	Line Type	Line Label	Area/Symbol Attribute
190	0201	Pipeline	GMISCULT	3 or 4		PIPELINE
190	0202	Power Transmission Line	GMISCULT	1		
190	0203	Telephone or Telegraph Line	GMISCULT	2		
190	0204	Aerial Tramway, Ski Lift	GMISCULT	5	(Label per Type)	

Application: Multiple Element Types

Major Code	Minor Code	Description	Idaho ADS Theme	Line Type	Line Label	Area/Symbol Attribute
190	0403	Landing Strip	GMISCULT	6	LANDING_STRIP	
190	0406	Pumping Station	GMISCULT	Symbol	3	PUMPING_STATION

Type of Code: Descriptive
Application: Multiple Element Types

Major Code	Minor Code	Description	Idaho ADS Theme	Line Type	Line Label	Area/Symbol Attribute
190	0600	Underground	GMISCULT	3		
190	0603	Above Ground	GMISCULT	4		

APPENDIX E - Boundary Data Records 1985 and Beyond

Type of Code: Feature Identification
Application: Areas

Major Code	Minor Code	Description	Idaho ADS Theme	Line Type	Line Label	Area/Symbol Attribute
090	0100	Civil Township or District	GPLANDLINES	3		
090	0101	Incorporated City	GPLANDLINES CARTOBOUNDS	6 4		
090	0103	National Park, Recreation Area	GPLANDLINES CARTOBOUNDS	5 9		
090	0104	National Forest or Grassland	GPLANDLINES CARTOBOUNDS BOUNDARIES	5 6 2		
090	0105	National Wildlife Refuge, Game Preserve	GPLANDLINES CARTOBOUNDS	5 1		
090	0106	National Scenic Waterway, Riverway Wilderness Area	CARTOBOUNDS	1		
090	0107	Indian Reservation	GPLANDLINES CARTOBOUNDS	5 7		
090	0108	Military Reservation	CARTOBOUNDS	9		
090	0111	Miscellaneous Federal Reserve	CARTOBOUNDS	9		
090	0130	State Park, Recreation Area or Lake	CARTOBOUNDS	8		
090	0131	State Wildlife Refuge, Game Preserve, Fish Hatchery	CARTOBOUNDS	2		
090	0132	State Forest, Grassland	CARTOBOUNDS	2		
090	0133	State Prison	CARTOBOUNDS	2		
090	0134	County Game Preserve	CARTOBOUNDS	3		
091	00__	State FIPS Code				
092	00__	County of County Equivalent FIPS code				
099	00__	Coincident Feature				

APPENDIX F - Manmade Feature Data Records 1985 and Beyond

Type of Code: Feature Identification
Application: Lines

Major Code	Minor Code	Description	Idaho ADS Theme	Line Type	Line Label	Area/Symbol Attribute
200	0206	Fence Line	IM.PROJECTS	1		

Application: Points

Major Code	Minor Code	Description	Idaho ADS Theme	Line Type	Line Label	Area/Symbol Attribute
200	0314	Guzzler	IM.PROJECTS	Symbol 8		

Application: Multiple Element Types

Major Code	Minor Code	Description	Idaho ADS Theme	Line Type	Line Label	Area/Symbol Attribute
200	0425	Tank	IM.PROJECTS	Symbol 4		WATER_TANK

Type of Code: Descriptive
Application: Multiple Element Types

Major Code	Minor Code	Description	Idaho ADS Theme	Line Type	Line Label	Area/Symbol Attribute
200	0604	Water	IM.PROJECTS	Symbol 4		WATER_TANK
203	0___	Angle of clockwise rotation				

ITEMS TO ADDRESS

1. Coincident Features.
2. Road Width Codes.
3. Number of Highway Lanes. Our menu doesn't specify all DLG catagories.
4. Copies of DLG Book to Co-workers.
5. Need to Incorporate Boundary Polygon Types.
6. Railroad Sidings and Car Lines - Are these Multiple Tracks?
7. Address Long Line Labels, e.g. Railroads.
8. Boundaries theme - add to the menu for more types or use another menu.
9. The DLG to ADS program needs to change line width to 0.00 instead of 0.06 the way it does now.
10. The feature 50 301 is a non-flowing well. Shall we take it to the well symbol and give it a label of well?
11. Unable to break out the 50 200 code in all cases. This could mean a river shoreline or a perennial lake (one case was seen like this).
12. The water tank width in IM.PROJECTS should be .10 inches instead of the menus .15 inches.
13. Spring and well symbols: USGS = .02 inches, BLM = .10 inches.

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What Can One Do With An ESRI Plot File???

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Abstract

In Oregon BLM augments GISPLOT with a custom plot driver called MOSSPLT. This driver adds several capabilities to the way we create finished map products. These include added support for Calcomp Electrostatic Plotters and the ability to translate ADS, MOSS/MAPS, and COS plot files to AutoCad DXF format.

MOSSPLT supports online plotting to Calcomp Electrostatic Plotters connected to a local Prime Computer via high speed parallel communications or via serial lines. This implementation provides transparent access to remote plotters over Primenet, multiple copy options, rescaling and rotation options, and personal pen definition files. We also provide an elaborate plot queue management system which includes plot banners, log files of plotting activity, and the ability to prioritize plots in the plot queues.

MOSSPLT can also be used to translate an ESRI generic plot file produced by ADS, MOSS/MAPS, or COS into an AutoCad DXF file. From there this file can taken into AutoCad or hundreds of other commercial programs which read DXF files. This gives us limited ability to edit our plots, and it gives us the ability to output GIS products on a wide variety of plotters and printer plotters.

1. Introduction

Although Geographic Information Systems (GIS) are expensive and complex they can be extremely valuable to large land owners and planning agencies in managing resources efficiently. The federal government recognized this long ago. As a result several federal agencies have funded and created a great deal of GIS software. Among the earliest of this software was a public domain GIS package called MOSS.

MOSS has been in the public domain for well over a decade. As with most public domain products, many different developers have added to MOSS, and different versions now exist. These versions differ a great deal. For example, most versions of MOSS currently in use have two GIS analysis subsystems, one for vector GIS and another for raster GIS. However, there are exceptions to this. Moreover, the original MOSS program did not provide a data capture facility to prepare MOSS data. Thus, developers created several different data capture programs for MOSS. Likewise, plotted maps produced by the original MOSS were not up to cartographic standards. Thus, software developers created programs to augment MOSS's plotting ability. Most users consider some or all of these add on programs to be part of the MOSS system. As a result, different people mean different things when they use the term MOSS.

The authors of this paper use the term MOSS Family of Software for the entire collection of programs usually used in collecting and analyzing maps in the MOSS GIS. In this paper we are only concerned with the BLM Subset of the MOSS Family of Software. By this we mean the set of programs BLM is currently using on their Prime Computers to collect and analyze map data in the MOSS GIS. This collection includes:

ADS or Automated Digitizing System

This is a data entry program that BLM uses to manually digitize map data from manuscripts. ADS can also accept ready made data in DLG3 and other formats. It has very limited data analysis capacity. It can often be used to produce good quality plotted maps.

MOSS

MOSS is a main program which consists of two major subsystems.

(1) MOSS or Map Overlay and Statistical System
    This subsystem is for handling vector map data
(2) MAPS or Map Analysis and Processing System
    This subsystem is for handling raster map data

Neither subsystem has extensive data capture ability, but data can be imported from other sources such as ADS or ready made DLG3s, DEM, etc. and MOSS maps can be rasterized to form MAPS maps. Both MOSS and MAPS have extensive data analysis abilities. Maps in both subsystems can be used to produce quality plotted maps.

COS or Cartographic Output System

While quality plots can be produced from MOSS, there are many limitations on the number of colors one can use, the line types one can use, the number of maps one can plot together, the placement of legends and labels, and what not. COS frees users from these limitations. COS has no data entry or analysis ability and exists solely for creating elaborate plots from MOSS and MAPS maps.

There are many brands and models of plotters on the market today. All plotters are driven by passing ASCII or binary codes from the host computer to the plotter which give the plotter instructions like:

```
PEN_UP
SELECT_PEN 17
PEN_DOWN
MOVE_FROM (-1.234,3.245) TO (5.234,4.567)
```

The exact language for these plotter codes varies a great deal depending on the brand and model of plotter. Some of the more common languages are:

Bit Map
Many printer plotters can be used for plotting, but they don't provide programmers with much support. Instead they expect to receive an array of zeros and ones describing which bits to turn on and which to leave off.

Calcomp 906/907
These drive Calcomp pen plotters and Calcomp electrostatic plotters.

HPGL
This is a graphics language Hewlett Parkard developed for their plotters. It is a very primitive language without flow control or variables. However, it is easy to read and as become something of an industry standard. Many non HP plotters understand HPGL.

Postscript
This is a full feature highly recursive computer language especially designed for graphics. It includes variables and loops and functions. Some plotters like QMS and Apple laser printers can accept this code. Plotters in this category require substantial internal computing power and usually have on board 68000s or something similar.

Tektronix
This is a very compact binary language developed by Tektronix for their graphics terminals. Nearly all graphics terminals understand and use Tektronix codes. A few pen plotters also use this language.

ZETA
This is a compact ACSII based language used by Zeta plotters.

ETC.
This is only a sampling of the hundreds of languages used to drive plotters.

This lack of standards among plotters gives software developers a great deal of pain. Originally ADS, MOSS/MAPS, and COS were written to drive specific makes and models of plotters. This did not work very well. Users needed flexibility in purchasing different makes and models of plotters. They often found they needed to use plotters originally purchased for other programs. In small offices users wanted to use the same equipment for both GIS and CAD. These needs lead to requests to make ADS, MOSS/MAPS, and COS support more devices. However, adding support for additional devices required major changes to the software. Moreover, plot drivers often require operating system dependencies. Thus, adding device drivers to ADS, MOSS/MAPS, and COS would make the software less and less portable.

These problems came to a head in 1986 when ESRI was porting the BLM Subset of the MOSS Family of Software from Data General Computers to Prime Computers. At that time the decision was made not to support any hard copy output devices directly. Instead, all of the software would write plot information into meta files called ESRI Generic Plot files. Other developers could then write relatively simple driver programs which would translate these ESRI Generic Plot files into machine specific codes and send these codes to the desired device.

In the early days DSC/ESRI developed:

- PLIST to translate the ESRI generic plot files into ASCII coordinates
- SHOW to translate the ESRI generic plot files into code for monochrome tektronix terminals
- MOSSPLOT to translate the ESRI generic plot files into code for various pen plotters. As we recall, Calcomp pen plotters, Hewlett Packard pen plotters, Zeta pen plotters, and Kongsberg flat bed plotters were supported by MOSSPLOT.

In Oregon BLM/IDI developed:

- MOSSPLT to translate the ESRI generic plot files into machine code for Calcomp electrostatic plotters and send it to the plotters. This driver ran as a background process, had full network support, would support fast parallel connections between the Prime and the plotter, and made it relatively easy to use graphics software other than the MOSS Family of Software with the same plotter.

More recently BLM/TGS has written two new drivers. These are:

- METALIST which seems to a rewrite of PLIST to allow the output to go into a file or directly to the terminal.
- GISPLOT combines the SHOW command and the MOSSPLOT command. In this rewrite full support has been added for Tektronix color terminals, partial support has been added for Calcomp Electrostatic plotters, and support has been dropped for Hewlett Packard and Zeta pen plotters. Many features have been added. These give increased pen palette support and plot rotation and overlay capacities. GISPLOT also has very good support for Calcomp pen plotters allowing users to change pens in the middle of plots. This effectively increases the number of colors one can use on a Calcomp pen plotter from two, four, or eight (depending on the model number) to as many as a user desires.

Meanwhile in Oregon BLM/IDI enhanced:

- MOSSPLT to continue to provide increased support for Calcomp Electrostatic plotters and to provide partial support for AutoCad DXF "plotters".

The rest of this paper is devoted to discussing the enhanced MOSSPLT driver. However, the reader should note that MOSSPLT does not replace the other drivers. METALIST, GISPLOT, and MOSSPLT all excel at different tasks. They are complimentary rather than redundant.

2. Examples of MOSSPLT in Action

MOSSPLT has two different user interfaces. The first is a command line interface which is very much like Prime's SPOOL command. Most users use this interface exclusively. It is very easy to use and since it sends the computational work to a batch queue, users get fast terminal response. The second interface is interactive. A few users prefer this interface. It is very useful in testing MOSSPLT. It allows users to access a few advanced features which are not available to command line users. The most important of these features is the ability to overlay multiple plot files.

2.1 MOSSPLT -- The Command Line Interface

Generally, sending a plot to the Calcomp Electrostatic plotter is as simple as typing:

```
MOSSPLT M.WOREGON
```

where M.WOREGON is an ESRI generic plot file produced by the GENPLOT or PENPLOT command in MOSS.

This assumes that one is using the PORT2 computer which has the electrostatic plotter connected to it. If instead one is using any of the other ten Prime computers BLM has in Oregon one can send the plot to the Calcomp Electrostatic plotter by typing:

```
MOSSPLT M.WOREGON -ON PORT2
```

If one wishes to make multiple copies of the plot or rescale the plot or rotate the plot, one can do this by typing a command like:

```
MOSSPLT M.WOREGON -ON PORT2 -COPY 10 -SCALE .50 -ROTATE
```

One can defer the processing of this plot to next year and request that it be plotted on mylar by typing a command like:

```
MOSSPLT M.WOREGON -ATT CALCOMP MYLAR -DEFER 01/01/92.00:00:00
```

By default MOSSPLT uses color definitions which we generalized from GISPLOT's color definitions. However, we have several alternate color definition charts which users can use, or if they desire they can build their own custom color definition chart. For example, a user can plot M.WOREGON entirely in black by typing:

```
MOSSPLT M.WOREGON -PENS CMDNC1>PRIORITY*>BLACK.ES.CHART
```

Another useful feature of MOSSPLT is that it supports wild cards. Thus, one can plot every ADS production plot in a directory by typing:

```
MOSSPLT P.@@
```

All of the above examples were for sending plots to a Calcomp Electrostatic plotter. If instead one wants to create AutoCad DXF files one would type a command like:

```
MOSSPLT P.@@ -DXF
```

Finally, one should note that MOSSPLT accepts full path names. Thus, commands like

```
MOSSPLT MANDEL>ADS_WORK>P.@@
```

are quite acceptable. This feature is very important in maintaining system security. MOSSPLT has to create temporary files. Thus, one must have ALL access rights in the directory from which one runs MOSSPLT. However, one only needs LUR rights to the directory containing the plot files themselves if one runs MOSSPLT from another directory.

2.2 MOSSPT1 -- The Interactive Interface

This is a fairly advanced user interface and we are not going to describe it fully. However, this interface allows users to merge or overlay multiple plot files.

The interface prompts the user by asking him or her questions. The user may answer in lower or upper case. All answers are checked for spelling and general reasonableness and the user is given chances to correct unrealistic answers. MOSSPT1 allows users to edit their responses using Prime's ECL. MOSSPT1 is run at the terminal instead of in a batch queue like MOSSPLT. Since MOSSPT1 can tie a terminal up for a long time, it gives users an opportunity to bail out after answering all the questions and finish the processing in batch. This is very convenient.

3. Technical Details of the Calcomp Option

From a technical point of view there are four keys to making MOSSPLT work as well as it does.

First, MOSSPLT uses a command line format as the preferred format. This format makes wildcarding very easy. It also makes it easy for MOSS macro developers to include MOSSPLT commands in their macros.

Second, MOSSPLT does it's processing in a batch queue. This keeps users free for interactive work. It also insures that no more than one MOSSPLT translation can be taking place at any given time. This smooths systems response.

Third, MOSSPLT uses Prime's spooler to deliver the translated plot file to the plotter. This means that one can physically wire the plotter to the Prime computer using any system supported by Prime's spooler. This includes parallel as well as serial ports. This is important because plot files are very large and a parallel connection will transfer data to the plotter 10 times as fast as a serial connection. It can take 10 hours to transfer a 30 mb plot file to a plotter using a serial line. BLM in Oregon often plots over one hundred plots per day on their one Calcomp Electrostatic plotter. This would be impossible if we were using serial communications.

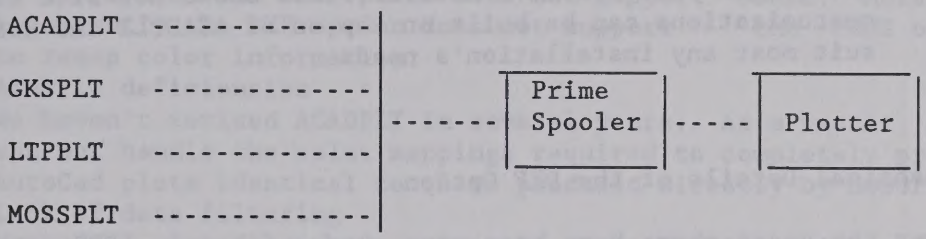
However, there are other advantages to using Prime's spooler to deliver plot files to the plotter. For example, Prime's spooler supports remote spooling from one computer to another. MOSSPLT inherits this from Prime's spooler. Prime's spooler has an elaborate print queue management system to help operators schedule printing and print the right document on the right paper, etc. MOSSPLT inherits all of this from Prime's spooler.

Fourth, MOSSPLT is very modular. Among other things MOSSPLT breaks the plotting process into two very separate parts.

(1) The plot file translator
(2) The plot file delivery system or spooler

This gives us the possibility of using the plot file delivery system with other translators. This is critical because this makes it very feasible to use the same plotter and plot delivery system for a wide variety of software. Thus, one plotter can be used for ADS, MOSS/MAPS, and COS, and AutoCad, and Harvard Graphics, and GKS totally and completely transparently. (Of course, each application requires a separate but reasonably small programming effort.)

The Oregon Plot System
for
Calcomp Electrostatic Plotters



3.1 Plot Queue Management System

The BLM in Oregon only has one electrostatic plotter. It resides in Portland and is connected to a Prime 6650 computer whose name is PORT2. The plotter is a Calcomp 5845-XP. This is a 44 inch full color plotter electrostatic plotter. This one little plotter has to do a lot of plotting. People are routinely sending plots to the plotter from AutoCad and the BLM Subset of the MOSS Family of Software. In the near future plots may be coming from LTPlus and GKS as well. Moreover, the majority of the plotting originates on Prime computers other than PORT2. Users in district offices do all their work on their district's Prime. They may then send plots to the Calcomp Electrostatic Plotter with a command like:

```
MOSSPLT M.S30W++FUN -ON PORT2
```

They expect the resulting plots to be mailed to them.

We often do one hundred plots per day and have sometimes done over two hundred plots in a day. The plot queue of files waiting to be plotted usually contains fifty to one hundred requests. At times it has exceeded 1500.

Plotting is a major task for Computer Operations in Oregon. One can not do the plots on a first come first serve basis. Instead management must schedule plotting activities to make sure that everyone meets their deadlines. Operations is also responsible for getting completed plots mailed or otherwise delivered to the right person. Computer Operations must also make sure that requests for paper or mylar are satisfied.

MOSSPLT and Prime's SPOOLER provide many tools to help Computer Operations manage the plot queues. These tools include:

(1) MOSSPLT.LOG
MOSSPLT keeps a log file. This contains enough information so Computer Operations can actually resubmit most MOSSPLT commands in case there would be a major lost. We have included an excerpt from a MOSSPLT.LOG file in an appendix to this paper.

(2) All Normal Prime Spool Management Features
Prime's spooler is designed for printers. It has features to help schedule large print jobs and to use multiple forms or types of

paper. It is also designed to handle hugh print queues. By default, Prime's spooler also put banners on printouts giving the user's name and the time and date of the print job. This banner is an ASCII file which can be not plotted. Thus, MOSSPLT turns this feature off and replaces it with a banner generated by the MOSSPLT translator.

(3) Additional tools
Computer Operations has written custom tools which use (1) and (2) as input. These programs give operations summary information on a weekly and monthly basis, and it warns them when plots in the queue get very old. We do not consider these tools to be part of the Oregon Plot System. However, this shows how site dependent customizations can be built on top on of ACADPLT and MOSSPLT to suit most any installation's needs.

4. Technical Details of the DXF Option

Over the years there have been many attempts to move digital map data from ADS, MOSS, and MAPS into AutoCad. Generally, software developers have had very limited success with this idea. ADS, MOSS, and MAPS maps have so many many different formats. Supporting a translator that could translate any ADS, MOSS, or MAPS map into AutoCad would be a major undertaking. Moreover, ADS, MOSS and MAPS are GIS tools where as AutoCad is a CAD tool. This is a very important difference. A GIS tool puts lots of importance on attribute information and on map topology. The data structures are designed to support numerical geometry and boolean algebra. A CAD tool puts much less importance on these, but puts lots of importance on line type and color information. Most of the MOSS to AutoCad translators have tryed to translate the attribute and topological information into the CAD setting. This simply is not possible!

We have taken an entirely different approach. Rather than translating the geographic data to AutoCad, we translate the ESRI plot files produced by the GIS into AutoCad. We are only concerned with the plot image (ie. the pen movements). We make no attempts to give any meaning to geographic attributes or special topologies. Since we are not handling geographic data we don't attempt to preserve geographic coordinate accuracy.

Theoretically, this is a much less ambitious and thus less useful than writing a true GIS to CAD translator. However, in practice we find most users don't really need a GIS to CAD translator. They want to do things like:

(1) Using AutoCad to add logos and labels to plots
(2) Using AutoCad to plot to devices not supported by GISPLOT or MOSSPLT
(3) Making PC based demos to give at conferences
(4) Including GIS displays in documents produced with Desk Top Publishers

All of these tasks have more to do with processing the plotted image produced from the GIS data than it has to do with the data itself. The DXF option is MOSSPLT is perfect for these applications.

MOSSPLT translates the ESRI plot file to AutoCad DXF. This results in a very different AutoCad drawing file than a GIS to CAD translator would give. The drawing file has 1024 layers named PEN0001, PEN0002, PEN0003, etc. Each layer corresponds to a color on the Calcomp plotter. Every pen movement gets translated into an AutoCad PLINE. Thus, shaded areas become PLINEs. Also, the MOSS software draws much of it's text instead of using plotter text commands. This drawn text gets translated into AutoCad as PLINEs rather than

AutoCad TEXT. Finally, all coordinates in the drawing file are in map inches. Geographic distances in miles or feet are totally meaningless in this setting.

The DXF translator in the current version of MOSSPLT (version 3.12) is very new and still experimental. It is reliable and works very well, but it is primitive in many ways. Still it is proving to be an exceedingly useful tool and we believe further enhancements to this translator would be worthwhile. Weaknesses in the current version include:

(1) Too many layers
MOSSPLT produces 1024 layers even if most of them are unused. This clutters the drawing file.

(2) Missing features provided in the Calcomp option
At the moment the DXF option does not support -SCALE. More importantly the DXF option does not support the -PENS option to remap color information.

(3) ACADPLT deficiencies
We haven't revised ACADPLT in several years. As a result, ACADPLT can not handle the color mappings required to completely produce AutoCad plots identical to those produced directly by MOSSPLT.

(4) Lack of data filtering
Many ESRI plot files have extremely tight shading which could be weeded without reducing plot quality at all. Doing this would reduce the size of the resulting Calcomp or DXF files a lot. This is important because many DXF files produced by MOSSPLT are 10 mb or more.

6. Future Possibilities

The last section discussed the DXF option of MOSSPLT and described ways it could be enhanced. We believe these enhancements are important because we feel this DXF option is the most important part of MOSSPLT.

The Calcomp side is less important. It is also much more mature so it needs fewer enhancements. However, we do see the need for a couple enhancements:

(1) Our current implementations of MOSSPLT assume that the Calcomp plotter will be attached to the Prime Computer by either a serial or a parallel line. This was all that was available when we purchased our Calcomp. Today many people are attaching their plotters directly to TCP/IP ethernet. The current version of MOSSPLT can be used with these plotters, but it isn't transparent and simple. We have successfully prototyped schemes which prove that a transparent system could be developed.

(2) Currently, all of our GIS software and most of our non GIS software produces filled areas by shading the area with thousands and thousands of individual pen moves. Raster based plotters like Calcomp Electrostatic plotters have commands in them for plotting filled polygons directly without using shading. Direct polygon fills result in small plot files, quicker plotter rasterization times, and better looking plots. MOSSPLT is not designed to do polygon area fills and it is not practical to add this to MOSSPLT because of the way ADS PLOT, PENPLOT, and GENPLOT work. However, we are looking into ways of taking the ESRI plot files into a raster based software package which could in turn produce Calcomp plot files using polygon fills.

Finally, we see the need for additional plotter support for ESRI files. One can plot to most any device by using the DXF option in MOSSPLT and then using AutoCad's plotter support. This works well if one is only doing occasional plots. However, if one wants to do more than five or ten plots per week on a particular plotter this system becomes clumsy. Direct drivers are much more efficient for large volume plot production. In particular, we foresee needs for HPGL and/or Postscript translators.

7. Acknowledgments

Dennis Owen from IDI coded the early versions of MOSSPLT. Ali Shamsapour from IDI prototyped schemes which may someday be used to support ethernet. David Culley from TGS gave us many ideas. In particular, we found his work on GISPLOT extremely useful. Mike Whetter from IDI wrote the MOSSPLT Users Guide. We also want to thank Mark Koski, BLM; Jay Ruegger, BLM; Lance Finnegan, BLM; and Wendy Tetley, BLM for their help designing and testing MOSSPLT and for their general encouragement. Finally we thank Pat Green, BLM and Harvey Holien, IDI for their support.

Appendix I

The following is a sample taken from a MOSSPLT.LOG file.

```
TYPE M.E_S21W01BFX.PLT IS BEING PROCESSED.              21 Nov 91 15:51:08 Thursday
ATTACH <P0207>PLOT_ARCHIVE>MOSS>BFX_SVALLEY
MOSSPLT M.E_S21W01BFX.PLT -PENS BFX_COLOR
TYPE
TYPE M.E_S17W01BFX.PLT IS BEING PROCESSED.              21 Nov 91 15:51:36 Thursday
ATTACH <P0207>PLOT_ARCHIVE>MOSS>BFX_MCKENZIE
MOSSPLT M.E_S17W01BFX.PLT -PENS BFX_COLOR
TYPE
TYPE M.E_S21W02BFX.PLT IS BEING PROCESSED.              21 Nov 91 15:52:20 Thursday
ATTACH <P0207>PLOT_ARCHIVE>MOSS>BFX_SVALLEY
MOSSPLT M.E_S21W02BFX.PLT -PENS BFX_COLOR
TYPE
TYPE M.E_S17W02BFX.PLT IS BEING PROCESSED.              21 Nov 91 15:53:00 Thursday
ATTACH <P0207>PLOT_ARCHIVE>MOSS>BFX_MCKENZIE
MOSSPLT M.E_S17W02BFX.PLT -PENS BFX_COLOR
TYPE
TYPE M.E_S21W03BFX.PLT IS BEING PROCESSED.              21 Nov 91 15:53:28 Thursday
ATTACH <P0207>PLOT_ARCHIVE>MOSS>BFX_SVALLEY
MOSSPLT M.E_S21W03BFX.PLT -PENS BFX_COLOR
TYPE
TYPE M.E_S22W01BFX.PLT IS BEING PROCESSED.              21 Nov 91 15:54:52 Thursday
ATTACH <P0207>PLOT_ARCHIVE>MOSS>BFX_SVALLEY
MOSSPLT M.E_S22W01BFX.PLT -PENS BFX_COLOR
TYPE
TYPE M.E_S22W02BFX.PLT IS BEING PROCESSED.              21 Nov 91 15:56:36 Thursday
ATTACH <P0207>PLOT_ARCHIVE>MOSS>BFX_SVALLEY
MOSSPLT M.E_S22W02BFX.PLT -PENS BFX_COLOR
TYPE
TYPE M.E_S22W03BFX.PLT IS BEING PROCESSED.              21 Nov 91 15:58:16 Thursday
ATTACH <P0207>PLOT_ARCHIVE>MOSS>BFX_SVALLEY
MOSSPLT M.E_S22W03BFX.PLT -PENS BFX_COLOR
TYPE
TYPE M.E_S23W01BFX.PLT IS BEING PROCESSED.              21 Nov 91 15:59:56 Thursday
ATTACH <P0207>PLOT_ARCHIVE>MOSS>BFX_SVALLEY
MOSSPLT M.E_S23W01BFX.PLT -PENS BFX_COLOR
TYPE
TYPE M.E_S19E01BFX.PLT IS BEING PROCESSED.              21 Nov 91 16:01:00 Thursday
ATTACH <P0207>PLOT_ARCHIVE>MOSS>BFX_MCKENZIE
MOSSPLT M.E_S19E01BFX.PLT -PENS BFX_COLOR
TYPE
```

Appendix II.

Using Prime's spooler as the plotter's delivery system is very powerful. For example, one can always list queued plot jobs by typing the Primos command:

```
PORT2: spool -list -nw
[SPOOL Rev. 22.1.1.R15 Copyright (c) 1990, Prime Computer, Inc.]
[Serial #IDBR-35QSBH-7S3N (U.S. Bureau of Land Management, Portland)]

System PORT2
Request  Time  User             File                             No Size  State
-------- ----- ---------------- -------------------------------- -- ----- -----
26 November 91
5396     17:23 SIROUS           S27W03POTC.PLT.MOSS               1  1464
5397     17:25 SIROUS           S27W04POTC.PLT.MOSS               1  775
5398     17:26 SIROUS           S26W04POTC.PLT.MOSS               1  150
5399     17:32 SIROUS           S24W01POTC.PLT.MOSS               1  2422
5400     17:35 SIROUS           S24W02POTC.PLT.MOSS               1  996
5401     17:38 SIROUS           S24W03POTC.PLT.MOSS               1  1014
5402     17:42 SIROUS           S24W04POTC.PLT.MOSS               1  1301
5403     17:47 SIROUS           S25W01POTC.PLT.MOSS               1  1849
5404     17:51 SIROUS           S29W05POTC.PLT.MOSS               1  1299
5405     17:54 SIROUS           S30W02POTC.PLT.MOSS               1  1282
5406     17:57 SIROUS           S30W03POTC.PLT.MOSS               1  1338
5407     18:01 SIROUS           S30W04POTC.PLT.MOSS               1  1159
5408     18:05 SIROUS           S30W05POTC.PLT.MOSS               1  1360
5409     18:06 SIROUS           S31W02POTC.PLT.MOSS               1  84
5410     18:11 SIROUS           S31W03POTC.PLT.MOSS               1  1555
5411     18:18 SIROUS           S31W04POTC.PLT.MOSS               1  2387
5412     18:24 SIROUS           S31W05POTC.PLT.MOSS               1  1906
5413     18:29 SIROUS           S31W06POTC.PLT.MOSS               1  1399
5414     18:30 SIROUS           S28W02POTC.PLT.MOSS               1  218
5415     18:34 SIROUS           S28W03POTC.PLT.MOSS               1  1519
5416     18:39 SIROUS           S28W04POTC.PLT.MOSS               1  1530
5417     18:41 SIROUS           S28W05POTC.PLT.MOSS               1  553
5418     18:45 SIROUS           S29W02POTC.PLT.MOSS               1  1237
5419     18:50 SIROUS           S29W03POTC.PLT.MOSS               1  1432
5420     18:53 SIROUS           S29W04POTC.PLT.MOSS               1  1111
5421     18:57 SIROUS           S23W01POTC.PLT.MOSS               1  1897
5422     19:01 SIROUS           S23W02POTC.PLT.MOSS               1  1283
5423     19:04 SIROUS           S25W08POTC.PLT.MOSS               1  1155
5424     19:07 SIROUS           S26W08POTC.PLT.MOSS               1  942
5425     19:11 SIROUS           S31W08POTC.PLT.MOSS               1  1730
5426     19:15 SIROUS           S31W09POTC.PLT.MOSS               1  1547
5427     19:19 SIROUS           S32W01POTC.PLT.MOSS               1  1678
5428     19:23 SIROUS           S32W06POTC.PLT.MOSS               1  1368
5429     19:28 SIROUS           S32W07POTC.PLT.MOSS               1  1846
5430     19:32 SIROUS           S32W08POTC.PLT.MOSS               1  1897
27 November 91
5484     10:08 J_JOHNSON        CO_TSEC_Q.MOSS                    1  1834
5494     12:24 SYSTEM           BIRD.CALCOMP                      1  78
5498     12:30 D_SMITH          SALEMB2.SALES.OKI                 1  3     Print
OK 12:31:13  1.396  0.072
PORT2: como -end
```

Appendix III.

The following pages contain sample output from MOSSPLT.

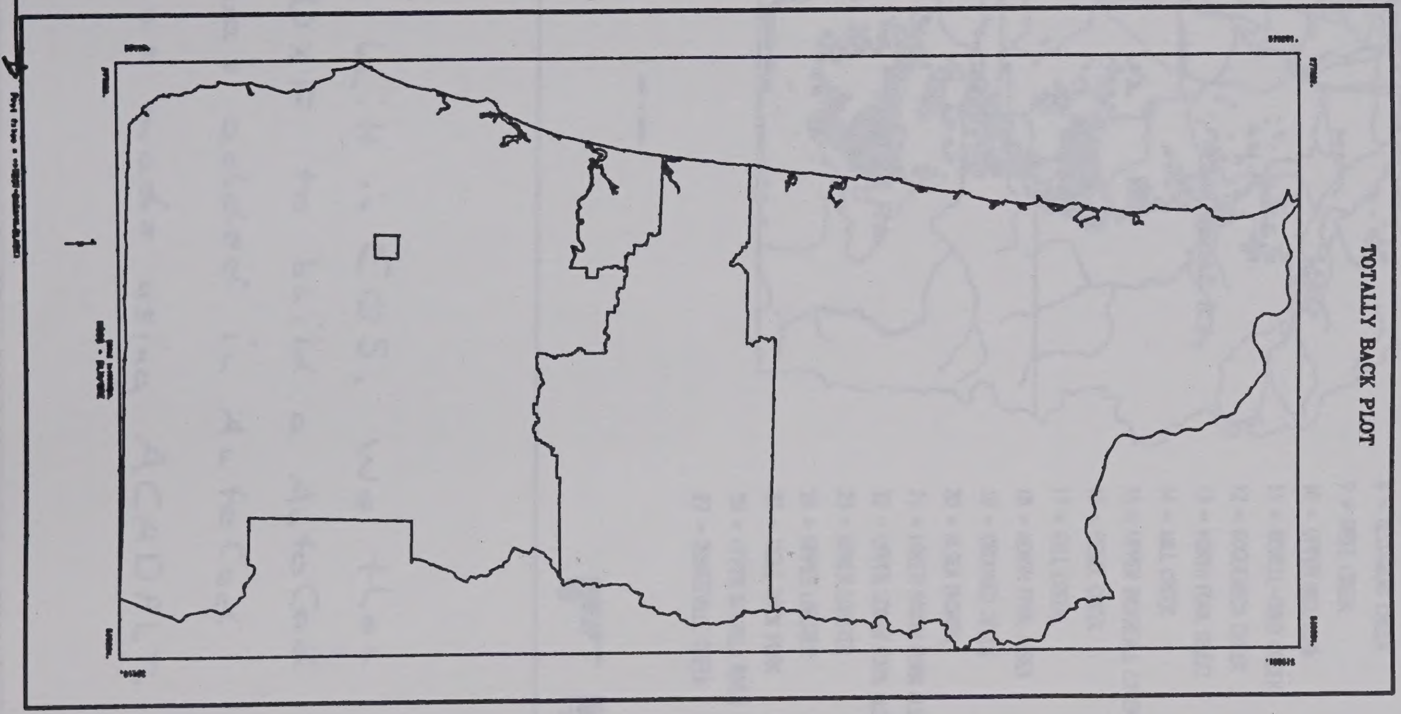
MANDEL

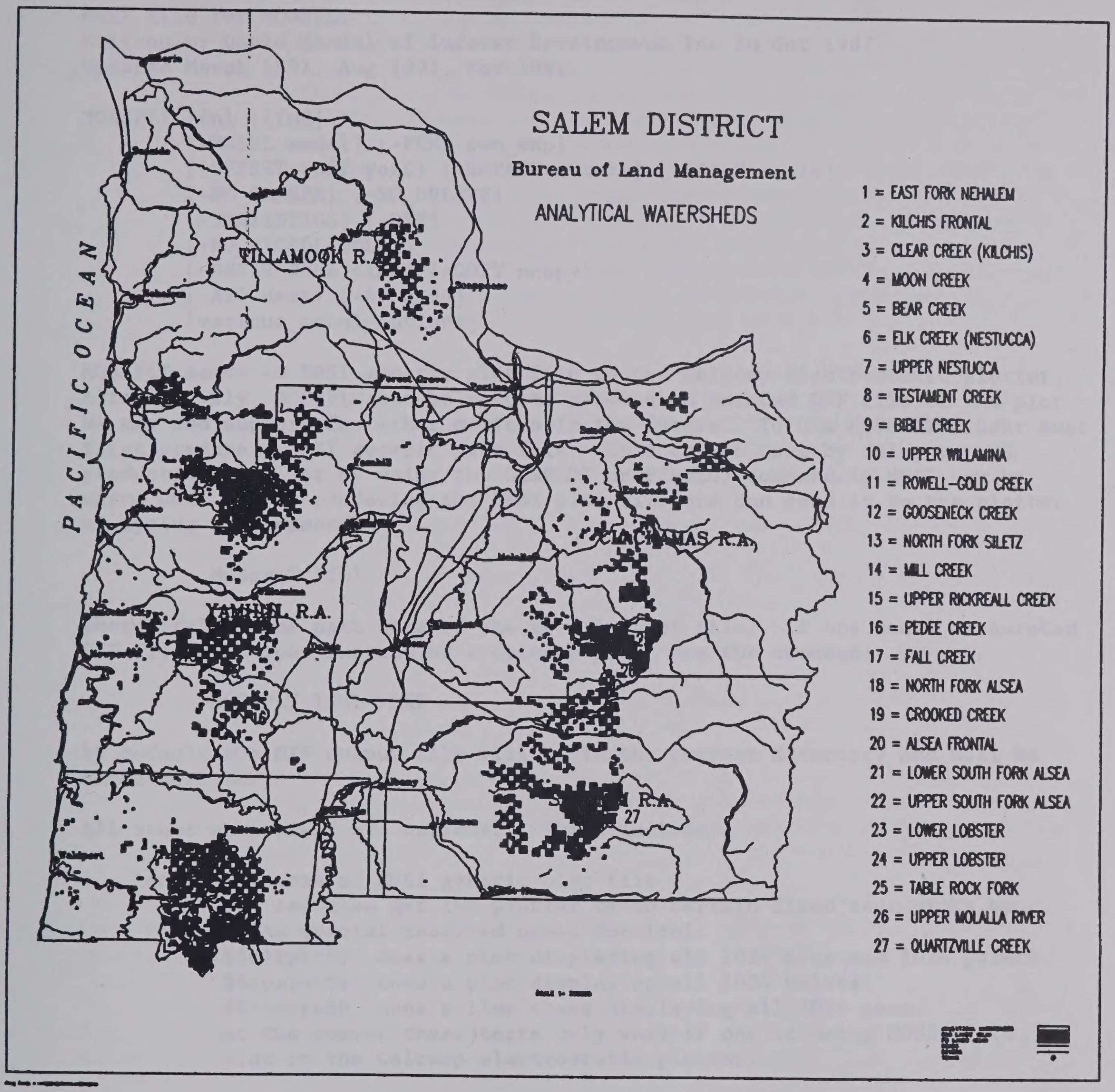
'File name = 'BLACK1.MOSS

'Plotted on '12/03/91' at 11:26 PM.'

Default banner produced by MOSSPLT translator.

Micro label — This serves as a plot inventory control number




SALEM DISTRICT
Bureau of Land Management
ANALYTICAL WATERSHEDS
PACIFIC OCEAN
TILLAMOOK R.A.
CLACKAMAS R.A.
YAMHILL R.A.
SANTIAM R.A.
27
26
1 = EAST FORK NEHALEM
2 = KILCHIS FRONTAL
3 = CLEAR CREEK (KILCHIS)
4 = MOON CREEK
5 = BEAR CREEK
6 = ELK CREEK (NESTUCCA)
7 = UPPER NESTUCCA
8 = TESTAMENT CREEK
9 = BIBLE CREEK
10 = UPPER WILLAMINA
11 = ROWELL-GOLD CREEK
12 = GOOSENECK CREEK
13 = NORTH FORK SILETZ
14 = MILL CREEK
15 = UPPER RICKREALL CREEK
16 = PEDEE CREEK
17 = FALL CREEK
18 = NORTH FORK ALSEA
19 = CROOKED CREEK
20 = ALSEA FRONTAL
21 = LOWER SOUTH FORK ALSEA
22 = UPPER SOUTH FORK ALSEA
23 = LOWER LOBSTER
24 = UPPER LOBSTER
25 = TABLE ROCK FORK
26 = UPPER MOLALLA RIVER
27 = QUARTZVILLE CREEK

The main plot was built in EOS. We then used MOSSPLT -DXF to build a AutoCad file. The frame was added in AutoCad and the hardcopy was made using ACADPLT.

HELP file for MOSSPLT
Written by David Mandel of Infotec Development Inc in Oct 1987.
Updated March 1991, Aug 1991, Nov 1991.

```
MOSSPLT lfn1 [lfn2]
        [-MODEL model] [-PENS pen_map]
        [-OFFSET xoff yoff] [-ROTATE rotate] [-SCALE scale]
        [-NO_BANNER] [-NO_DELETE]
        [-STATISTICS] [-DXF]
        [-NO_MICROLABEL]
        [-DEFER date.time] [-COPY ncopy]
        [-ATT dest] [-ON node]
        [various_spool_options]
```

MOSSPLT sends an ERSI generic plot file to the Calcomp Electrostatic plotter. Alternatively, MOSSPLT can be used to produce an AutoCad DXF file of the plot. We may add support for other devices in the future. To use MOSSPLT a user must first produce a ERSI generic plot file. This can be done by doing an ADS production plot, or by using the GENPLOT or PENPLOT command in MOSS, or by using COS. After producing the ERSI plot file one can send it to the plotter by typing the command:

```
MOSSPLT lfn1
```

where lfn1 is the path name of the generic plot file. If one wants an AutoCad DXF file as output instead of a Calcomp plot, use the command:

```
MOSSPLT lfn1 -DXF
```

By default the DXF output file will be in the current directory and will be named lfn1.DXF

All other parameters are optional. These include:

lfn1 = Pathname of ERSI generic plot file.
One can also get the plotter to do certain fixed test plots by using special reserved names for lfn1.
$$clrplt$$ does a plot displaying all 1024 pens and 1024 palets.
$$cpalet$$ does a plot displaying all 1024 palets.
$$lntyps$$ does a line chart displaying all 1024 pens.
At the moment these tests only work if one is using MOSSPLT to plot on the Calcomp electrostatic plotter.

lfn2 = The name of the reformatted plot file.
Normally, this is the name of the file which is actually submitted to the plotter. The default name is lfn1.MOSS and it is deleted before the user ever sees it. If lfn1.MOSS already exists, then the name MOSSPLT.OUT is used.
If the -DXF flag is set the default name is lfn1.DXF and it not deleted once MOSSPLT is finished. If lfn1.DXF already exists, then the name MOSSPLT.DXF is used.

-MODEL model specifies the model of plotter being used.
Currently supported models include:
1 for the Calcomp 1043 (not yet supported)
2 for the Calcomp 1044 (not yet supported)
3 for the Calcomp 1073 (not yet supported)
4 for the Calcomp 5845XP (Electrostatic)
5 to create an AutoCad DXF file

Normally, the default is model = 4.
If the -DXF flag is set the default is model = 5.

-PENS pen_map specifies a file containing pen color and wide definitions. Normally, the default is CMDNC1>PRIORITY*>MOSSPT1.ES.CHART Alternate pen charts for Calcomp electrostatic plotters include CMDNC1>PRIORITY*>BLACK.ES.CHART and CMDNC1>PRIORITY*>NULL.ES.CHART. These are documented in comment statements in the pen charts. These comment statements also give enough information that very ambious users can design and create their own personal pen charts. If the -DXF flag is set the default is CMDNC1>PRIORITY*> MOSSPT1.VGA.CHART. The current version of MOSSPLT does not use this information, but future versions may. Since these charts aren't used yet, the format of the DXF charts will probably change.

-OFFSET xoff yoff specifies a translation in inches to move the plot origin. By default MOSSPLT reads the minimun x and y value from the ERSI file and translates the plot enough to make the entire plot in Cartesian quadrant I (ie. The new x and y coordinates are non negative.)

-ROTATE rotate specifies the number of degrees to rotate the plot around (0.,0.) in the counter clockwise direction. The default is rotate = 0. To do a simple rotation specify:

```
-ROTATE 90
```

-SCALE scale specifies a scale factor to shink or expand the plot by. The default is 1. Using "-SCALE 0.5" halves the size of the plot. Using "-SCALE 2.0" doubles the size of the plot. Currently, this feature is ignored if the -DXF flag is set.

-NO_BANNER

MOSSPLT usually produces a banner giving the user's name, the name of the plot file, and the current date. -NO_BANNER turns this feature off.

-NO_DELETE

MOSSPLT works by translating the ERSI plot code into plotter machine code which is stored in the temporary file, lfn2. Normally, this file is deleted as soon as it is sent to the plotter. However, one can save this file by using the -NO_DELETE option. The -DXF flag sets this option automatically.

-STATISTICS

Some output devices such as the Calcomp Electrostatic plotters keep track of plot statistics which can be valuable in bench marking and debugging plot procedures. This flag turns on the printing of these statistics when they are available.

-DXF

This flag sets the other flags for DXF production. Thus, -DXF sets the new defaults to model = 5, pen_map = CMDNC1>PRIORITY*> MOSSPT1.VGA.CHART, scale = 1, and -NO_DELETE.

-NO_MICROLABEL

Normally MOSSPLT will generate a small label on the lower left hand corner of your plot with the names of the input file. The -NO_MICROLABEL flag will surpress this label.

-DEFER date.time specifies the time and date to start translating the ERSI file into machine code and to send the machine code to the plotter. Up until this time, the MOSSPLT job will remain in the batch queue. "date.time" format can be any of the following:

```
yy-mm-dd.hh:mm:ss          'dd mon yy hh:mm:ss'
mm/dd/yy.hh:mm:ss          'dd mon yy.hh:mm:ss'
```

The two formats on the right must be enclosed in single quotation marks; "mon" stands for a month's first three characters -- JAN, FEB, MAR, etc. All the other letters represent one- or two-digit numbers. The hh field uses 24-hour notation. Omitted date fields are replaced by current date information; omitted time fields are replaced by zeros. At job submittal, the acknowledgement message gives the date and time of deferral.

-COPY ncopy specifies the number of copies of one's map to make. Whenever possible MOSSPLT makes multiple copies by sending a multiple copy command to the plotter instead of sending ncopy copies of lfn2 to the plotter. Because of this ncopy must be in the range your plotter can understand. On Calcomp electrostatic plotters ncopy must be between 1 and 63.
If the -DXF flag is set, this option has no meaning.

various_spool_options = spool options which you want passed to the command that actually sends the file to the plotter. The most useful options are -ATT dest, and -ON node.
If the -DXF flag is set, these options have no meaning.

Notes for System Administrators and System Programmers

If one reads some of the program code for these programs, especially the code for MOSSPLT_HELPER.CPL you will see several options which have not been documented. These options are for systems use only and normal users should not use these. For the most part, these are to aid the developers with debugging and software testing.

To install MOSSPLT, one attaches to the main MOSSPLT directory, usually IS>OREGON_MODS>OREGON_PLOTSYS>MAIN_SYSTEMS>MOSSPLT and spools the MOSSPLT.HELP file. After reading it carefully one does the install by running:

```
CPL INSTALL_MOSSPLT
```

This program will copy all the required files to their proper locations as described in the next couple paragraphs. It will also set RWLOCKs and ACLs as required. It will not set up spoolers or batch queues. The systems administrator must do this by hand as described below.

Prime usually stores external Primos commands and custom commands developed for a particular installation in the same directory, namely CMDNC0. Since this is confusing, at the BLM in Oregon we store custom commands in various directories under CMDNC1. As written the MOSSPLT system (ie. MOSSPLT.CPL, MOSSPLT_HELPER.CPL, MOSSPT1.RUN, MOSSPT1.ES.CHART, MOSSPT1.VGA.CHART, etc) are stored in CMDNC1>PRIORITY*. This can easily be changed by making a couple obvious changes in MOSSPLT.CPL and MOSSPLT_HELPER.CPL before running the installation program. Also, MOSSPLT is coded to use a custom variation of the JOB command called SRJOB. MOSSPLT is coded to function properly using the JOB command at installations that do not have SRJOB. Finally, this help file, MOSSPLT.HELP will be put into HELP1*>PRIORITY* in Oregon and HELP* on most other systems.

The system's administrator can set up MOSSPLT system in such a way that MOSSPLT will keep a log of all MOSSPLT activity. This plot history is useful for keeping track of plotter usage. It can also be used by system operators to try to repeat plots which have been lost due to plotter malfunction. To use this system the system's administrator must simply make a short file called CMDNC1>PRIORITY*>MOSSPLT.LOG and use EDAC to give everyone all rights to it. Normally

```
        EDAC CMDNC1>PRIORITY*>MOSSPLT.LOG $REST:ALL
```

will do this.

It is probably also a good idea to set:

```
        RWLOCK CMDNC1>PRIORITY*>MOSSPLT.LOG NONE
```

The installation program will do all of this for the systems administrator. If he or she does not want to keep a log file, simply delete the MOSSPLT.LOG file. MOSSPLT will work properly and no log will be kept.

The MOSSPLT.LOG file can get very long quickly and slow system response down. Thus, the system's administrator should delete it's contents every couple days. Some system administrators prefer to only delete part of the contains of the file. That is fine. In either case we recommend using ED to accomplish this task, since this will make sure the file continues to exist and has the same ACL and RWLOCK values.

Some systems store this log file in CMDNC0 instead of CMDNC1>PRIORITY*. MOSSPLT as written will automatically adjust for this. If MOSSPLT.LOG does not exist in either CMDNC0 or CMDNC1>PRIORITY*, MOSSPLT will function correctly without keeping a log. Thus, the systems administrator can turn off logging by simply deleting this file.

To use MOSSPLT the system's administrator must set the system up in a certain way. First, if you are using MOSSPLT to plot to an electrostatic plotter MOSSPLT assumes that the plotter is attached to the Prime directly by a RS-232 port or a URC parellel port or some other manner recognized by Primes spooler system. The system's administrator sets the plotter up as a spooled device by using an environment file like:

```
          /* CALCOMP.ENV
          PARALLEL PR1
          DEVICE PRINTRONIX
          PRIORITY_TO_LOCAL_QUEUE
          LOG -ON
          ATTRIBUTE CALCOMP
          NODE -RING
```

and including CALCOMP in the SPOOL*>ATTRIBUTES>.DEFAULT_ATTRIBUTES. file of each system which is allowed to spool to this device.

Some installations have Calcomp electrostatic plotters that they can not or do not wish to set up as a spooled device. We are aware of a couple different situations of this type. The first is Calcomp plotters ran from magnetic tapes. The second is Calcomp plotters on ethernet.

There are a couple ways of handling these situations. The first and simplest is to have users use the -NO_DELETE options when submitting a MOSSPLT job. They can the copy the resulting file into a pool where opertors can either make tapes or ftp the file to the plotter.

A more complex but better method is to continue to use the CALCOMP spooler only do not start the spooler by typing PROP CALCOMP -START. MOSSPLT will continue to fill SPOOL_DATA* with plot files to be spooled, and users will be able to use all of the MOSSPLT options including -ON node. The system administrator can then write a CPL program which will look in SPOOL_DATA* and either put the Calcomp files on tape or ftp them to the plotter, and finally use SPOOL -CANCEL to delete the calcomp file and it's entry in the spooler data base.

In addition, each system must be running Prime's batch system and have a batch queue set up called CALCOMP with the characteristics:

```
    Queue name = CALCOMP, unblocked, uncapped.
    Active window = FULL;
    Default cptime=None, etime=None, priority=5;
    Maximum cptime=None, etime=None; Funit=6;
    Delta rlevel=2; Timeslice=20;
```

If one does not use batch, one can still use MOSSPLT by changing MOSSPLT.CPL to submit the jobs as phantoms.

MOSSPLT works as follows. First, MOSSPLT.CPL does a couple simple argument checks, updates the log file if it exists, and then submits a batch job using MOSSPLT_HELPER.CPL. This program handles most of the arguments and feeds them into the main translation program, MOSSPT1.RUN. If the user is making a plot file MOSSPT1.RUN will translate the ERSI file into Calcomp or other machine code and MOSSPLT_HELPER.CPL will then use Prime's spool command to send the machine code to the plotter. On the other hand, if the user is making a DXF file MOSSPT1.RUN will translate the ERSI file into DXF format and MOSSPLT_HELPER.CPL will save the DXF file for the user.

Users can run the system interactively by typing:

```
MOSSPT1
```

and answering it's questions. One of the questions asks the user if he or she wants to leave interactive mode. We recommend always answering no. MOSSPT1 can be used in this way to produce a translated plot file. If this is a Calcomp file one can send it to the plotter by typing:

```
SPOOL moss.out -ATT CALCOMP -NOHEAD -NOFMT
```

If the output is a DXF file, the user should not spool the resulting file, but instead use it directly. (ie. Down load it to a PC, get into AutoCad and use the DXFIN command to read it.)

This is not a recommended procedure and may not be entirely bug free. However, is can be useful in debugging problems and it will also allow users to merge several ERSI plots together.

Calcomp Plotter Setup

MOSSPLT allows a great deal of flexibility in configuring the plotter. It does required the plotter to be set to:

```
    Number of sync characters          =    1
    sync character                     = ^002
    EOM character                      = ^003
```

Calcomp plotters allow system administrators to store various users or setups within the plotter to keep pen and pallet information. MOSSPLT sends its own pen and pallet definitions to the plotter with each and every plot instead of using definitions in the plotter. This means systems administrators can use these setups for other software packages and be assured that MOSSPLT will never wipe their work out.

Planned future improvements.

Currently we support Calcomp electrostatic plotters. Someday we hope to add Calcomp pen plotters to this list.

Recently, we added support for AutoCad DXF formatted output files. At this time the DXF support is partial and we hope to improve it in the future. However, even this partial support is useful as it allows one to create plots on any of the hundreds of plotters AutoCad supports. The AutoCad option also allows one to get into many other systems including GENACAD, LTPlus and many desk top publishing systems. In the future, we hope to support color charts, so the AutoCad colors will look like what you get from the Calcomp plotters.

After this we may want to consider introducing data filtering into the package to eliminate unneeded plot data. We may also want to consider ways of using pallet fills instead of filling areas with vector shading. This would reduce the file sizes and yield cleaner colors.

also allows one to get into many other systems including GENACAD, [illegible] and many desk top publishing systems. In the future, we hope to support color charts, so the outputed colors will look like what you get from the Calcomp plotters.

After this we may want to consider introducing data filtering into the package to eliminate unneeded plot data. We may also want to consider ways of using pallet fills instead of filling areas with vector shading. This would reduce the file sizes and yield cleaner colors.

PROPOSED ENHANCEMENTS:

- Uses look-up tables to convert major/minor coding into proper line (symbol) menu pick in ADS.
- Uses look-up tables to convert attribute information into user-specified attribute name.
- Allows transfer of lines from one DLG source file into multiple ADS menus; from various DLG source files into one ADS menu.
- User specifies (via look-up tables) label and attribute parameters.
- Allows addition of DLG data to existing maps and data layers.
- Designed to ease future ADS to DLG work.

CURRENT ADS2DLG TRANSLATOR CAPABILITIES (summary):

- Converts DLG lines to line pick #5 in ADS menu

- For PLSS, converts area attributes into .A file in ALMRS format (e.g., 03; 029N0030W). For other layers, brings over major/minor code into .A file

- Gives option of bringing over lines with or without major/minor coding (becoming labels in ADS)

- "Hardcodes" label width, label height, label angle, and font

- Assumes no other data layers exist for this file (builds ADS.mapname and .BORDER files each time.)

~~OK, slist cedahydro~~

```
 *** DLG-OPTIONAL FORMAT   PRODUCED BY USGS
CEDARHILL, ID                                       1973          24000
                                                                401,       _ 5 5 5
     3     1    12     2  .61000000000D+00     4       0      4      1
    -.11204101500000D+09     .42018045000000D+08     .00000000000000D+
     .00000000000000D+00     .00000000000000D+00     .00000000000000D+
     .00000000000000D+00     .00000000000000D+00     .00000000000000D+
     .00000000000000D+00     .00000000000000D+00     .00000000000000D+
     .00000000000000D+00     .00000000000000D+00     .00000000000000D+
  .10000000000D+01  .00000000000D+00  .00000000000D+00  .00000000000D+
SW          42.250000 -112.750000          355631.74  4678802.45
NW          42.375000 -112.750000          355917.05  4692682.58
NE          42.375000 -112.625000          366208.74  4692478.10
SE          42.250000 -112.625000          365944.17  4678598.17
HYDROGRAPHY                0    280    280 01      33      33 010    301    301
N     1     364797.58   4679998.24     0     2            0      0
      2      -2
N     2     364203.34   4690414.29     0     2            0      0
      3      -3
N     3     363074.17   4680473.82     0     2            0      0
      4      -4
N     4     363876.43   4689208.64     0     2            0      0
      5      -5
N     5     361809.00   4690415.99     0     2            0      0
      6      -6
N     6     361600.22   4690587.80     0     2            0      0
      7      -7
N     7     358708.28   4683260.15     0     2            0      0
      8      -8
N     8     358799.86   4692162.09     0     2            0      0
```

Header

projection

corners

theme

nodes

area

lines

Nodes

A=area

DIGITAL LINE GRAPHS (DLG'S)

Basic structure:

- HEADER INFO
- NODES
- AREAS
- LINES

Distribution formats:

- STANDARD
- OPTIONAL

TITLE: Converting USGS Digital Line Graphs (DLG'S) into ADS -- Current Capabilities and Proposed Enhancements

OUTLINE:

INTRODUCTION

BRIEF COMMENTS ON DLG'S
- Structure
- Major/Minor Coding

CURRENT CAPABILITIES, ADS2DLG

PROPOSED ENHANCEMENTS

Wyoming

+ GPS for Field Digitizing

- I. What is GPS
  - A. Current Status
  - B. How does it work
  - C. BLM Study-SPT
- II. Major GPS Applications
  - A. Navigation
    - 1. Trimble Pathfinder Basic
    - 2. Magellan
    - 3. Any GPS in Autonomous Mode
  - B. Resource Mapping (BLM/FS $8,500 to 9,500 ea)
  - C. Surveying (BLM ±$12,500)
  - D. Geodetic Use (±$40,000)
- III. Accuracy
  - A. Single unit-navigation mode (Autonomous Mode)
    - 1. DoD stated accuracy : 100 meters 98 % of the time
    - 2. Most tests have found it to be in the ±35 meters range
  - B. Differential
    - 1. Stationary (±5 meters = 1:12,000 with good procedures)
    - 2. On the Go (±12 meters = 1:24,000)
  - C. Survey (< 1 meters)
  - D. Geodetic (± cm)
- IV. Compatible to BLM GIS
  - A. Import to MOSS
  - B. No ADS Format
- V. GIS Uses
  - A. Field resource data collection
  - B. Update and maintenance

    C. Map Accuracy Testing
    D. Sampling for Remote Sensing

VI. Problems/Concerns

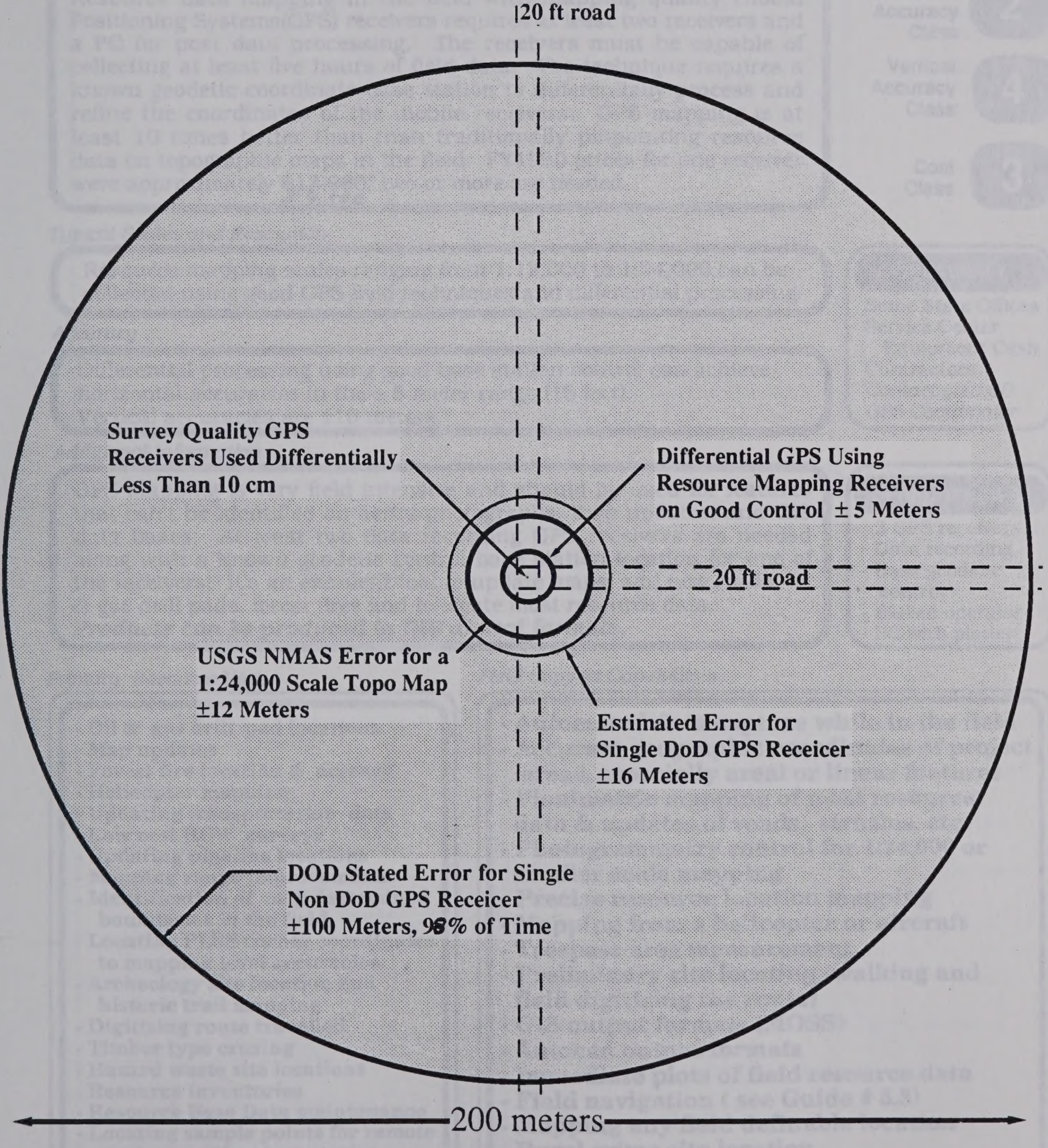
    A. Not fully operational for ±2 years
    B. High expectations
    C. Examine other mapping technologies
    D. No BLM infrastructure - should come up with a plan for its use
        1. Easy access control for base
        2. Base Stations → at office, can check if working
        3. Training
        4. Receivers
        5. Expertise
    E. Difficult to append a file
        1. Not in ADS format - you can generate command
        2. Import into MOSS & combine with another layer
    F. No data structure standards

VII. Recommendations

    A. Seed units throughout the BLM/FS for initial operational experience
    B. Address Standards
    C. Develop imports for ADS and LTP and other data entry formats
    D. Base Stations
    E. Interagency cooperation
    F. Training

not very good for trespass. Would not go into court with it

Graphic Comparison of GPS and Mapping Systems Accuracies


20 ft road
Survey Quality GPS Receivers Used Differentially Less Than 10 cm
Differential GPS Using Resource Mapping Receivers on Good Control ± 5 Meters
20 ft road
USGS NMAS Error for a 1:24,000 Scale Topo Map ±12 Meters
Estimated Error for Single DoD GPS Receicer ±16 Meters
DOD Stated Error for Single Non DoD GPS Receicer ±100 Meters, 95% of Time
200 meters

DRAFT

GPS Mapping

Two Receivers with Differential Processing

General Description of Geographic Coordinate System

Resource data mapping in the field with mapping quality Global Positioning Systems(GPS) receivers requires at least two receivers and a PC for post data processing. The receivers must be capable of collecting at least five hours of field data. The technique requires a known geodetic coordinate base station to differentially process and refine the coordinates of the mobile receivers. GPS mapping is at least 10 times better than than traditionally pinpointing resource data on topographic maps in the field. FY1990 prices for one receiver were approximately ~~$13,000~~ $9,500, two or more are needed.

Horizontal Accuracy Class	2
Vertical Accuracy Class	4
Cost Class	3

Typical Scales and Resolution

Resource mapping scales ranging from 1:12,000 to 1:24,000 can be collected using good GPS field techniques and differential processing.

Accuracy

Differential processing using good base station control can achieve horizontal accuracies in the ± 5 meter range (16 feet).
Vertical accuracies are ±10 meters.

AVAILABILITY

Some State Offices
Service Center
Equipment Cash
Contractors
Contact your SO GPS Coordinator

Additional Information

GPS Mapping is very field intensive and should be used for features that can't be identified on aerial photographs, map updates, and GIS data bases. At least two data recording GPS receivers are needed along with a known geodetic control base station location for one of the receivers. It's an excellent tool to update maps, add new roads, oil & gas drill pads, forest fires and to locate most resource data. ***Products can be produced in GIS digital formats.***

DEPENDENCIES

- 2 GPS receivers
- Data recording
- Base geodetic control
- Skilled operator
- PC with plotter

Primary Resource Uses

- **Oil & gas drill pad locations**
- **Map updates**
- **Forest fire location & acreage**
- **Helicopter mapping**
- **Updating transportation data**
- **Low cost ROW surveys**
- **Updating pipeline locations**
- **Mapping range improvements**
- **Identification of map determined boundaries in the field**
- **Locating PLSS corner coordinates to mapping level accuracies.**
- **Archeology site location and historic trail mapping**
- **Digitizing route travelled**
- **Timber type crusing**
- **Hazard waste site locations**
- **Resource inventories**
- **Resource Base Data maintenance**
- **Locating sample points for remote sensing or other inventories**

Field Support Capabilities

- **Automated data capture while in the field**
- **Accurate geographic coordinates of project areas, especially areal or linear features**
- **Planimetric mapping of most resource data & updates of roads, streams, etc.**
- **Photogrammetry control for 1:24,000 or smaller scale mapping**
- **Precise resource location mapping**
- **Mapping from a helicopter or aircraft**
- **Trespass area measurement**
- **Preliminary site locating (walking and field digitizing the route)**
- **GIS output formats (MOSS)**
- **Autocad output formats**
- **Immediate plots of field resource data**
- **Field navigation (see Guide # 5.3)**
- **Mapping any field definable location**
- **Rural crime site location**

Bureau of Land Management
9/9/90

DRAFT

GPS Surveying

Two or More Receivers with Differential Geodetic Processing

General Description of Geographic Coordinate System

Geodetic surveying can be performed with survey quality Global Positioning Systems(GPS) receivers and differential processing with first order geodetic control. Use of these GPS receivers requires a high level knowledge of geodesy and requires a known geodetic coordinate base station(s) to differentially process and refine the coordinates of points. BLM normally uses two base stations to differentially process highly accurate coordinates. Survey GPS receivers give the highest quality coordinates available. Individual receiver costs are approximately $25,000.00.

Horizontal Accuracy Class	**1**
Vertical Accuracy Class	**2**
Cost Class	**1**

Typical Scales and Resolution

Engineering scales larger than 1:6,000 can be obtained. Also used for absolute control for photogrammetry.

Accuracy

Differential processing using accurate base station control can achieve horizontal accuracies in the less than one decimeter(10 centimeters). Less than 1 meter vertical accuracies can be obtained.

AVAILABILITY

Some State Offices
Service Center
Equipment Cash
Contractors
Contact your SO Geodesist

Additional Information

GPS Surveying is very field intensive and should be used for expansion of 1st or 2nd order control for local GPS control for resource mapping projects or control for processing geographic coordinates for the PLSS Geographic Coordinate Data Base (GCDB). Geodetic post processing of the data is required for accurate coordinates.

DEPENDENCIES

- 2 or more Survey Quality GPS receivers
- Geodetic control
- Geodesy knowledge
- Skilled operators

Primary Resource Uses

- **Locating PLSS corner coordinates to surveying accuracy**
- **GPS coordinates for local control for mapping GPS base stations**
- **Mapping and photogrammetric control (absolute & relative)**
- **Airbourne photogrammetric control**
- **Earth crustal movements**
- **Oil & gas well head locations**
- **1st order control use to refine the horizontal datum (NAD 83)**
- **High relative accuracy surveys for engineering projects (kinematic surveys)**
- **Large scale Archeology sites base mapping (precise UTM coordinates)**
- **Trespass identification and measurements**
- **Resource Base Data project control**

Field Support Capabilities

- **High precision geographic coordinates of the Public Land Survey System landnet**
- **High precision geographic coordinates of points or existing survey monuments**
- **High precision base station coordinates for lower order GPS operations**
- **Photogrammetry control for 1:12,000 or larger scale mapping projects**
- **Absolute control (geodetic coordinates) of field resource projects**
- **Photogrammetric control of aerial photography from aircraft**
- **Base control for intensive large scale GIS projects**
- **See Mapping GPS (see Guide # 5.1)**

DRAFT

GPS Navigation

Using one GPS receiver in the Autonomous mode

General Description of Geographic Coordinate System

Field navigation can be performed with the lowest cost GPS navigation quality receivers, which were designed for offshore navigation. Department of Defence GPS security requirements limit accuracies to no worst than ±100 meters, but this limitation should not be implemeted until 1993. Field testing has obtained measurements up to 25 meters, but there is no way of knowing your accuracy with single GPS receiver use (autonomous mode). The navigation mode works well in aircraft and is more accurate than LORAN navigation systems. Some systems can store up to 199 waypoints. FY1990 prices for one navigation receiver were as low as $3,500.

Horizontal Accuracy Class 4

Vertical Accuracy Class 5

Cost Class 4

Typical Scales and Resolution

Resource data point mapping equal to 1:100,000 scale maps can be expected.

Accuracy

Department of Defence stated accuracies are to be no worst than ±100 meters when used in the autonomous mode.
Vertical accuracies are unreliable in the autonomous mode.

AVAILABILITY

Some State Offices
Service Center
Equipment Cash
Contractors
Contact your SO GPS Coordinator

Additional Information

Navigation GPS can be usefull for both airborne resource locations and ground navigation to map derived coordinates. Most GPS systems require coordinates to be converted to the new NAD 83 datum from the NAD 27 datum shown on topographic maps. Mapping level GPS systems can be used to navigate to a location, then more precise differential coordinate can be derived when two GPS Mapping systems with data recording are used.

DEPENDENCIES

- GPS receiver
- Limited training
- DoD Anti-Spoofing Code

Primary Resource Uses

- **Locate a specific drill pad in a oil & gas well field**
- **Locate a range transect site**
- **Locate old forest burns or prescribed burns**
- **Locate a range improvement**
- **Locate mapped or PLSS GCDB corner coordinates in the field**
- **Identification of non feature related boundaries in the field**
- **Field ID of preplanned route**
- **Locating sample points for remote sensing or other inventories**
- **Obtaining positions for flight following or feild vehicle location**

NOTE: Most of the above applications need pre-determined geographic coordinates to encode into the GPS as waypoints to navigate to the field location. See above accuracy statement.

Field Support Capabilities

- **Navigation to predetermined geographic coordinates by helicopter or aircraft**
- **Navigation to predetermined geographic coordinates by foot or car**
- **Preliminary site location (walking the route)**
- **Finding the location of non-ground feature boundaries while you are in the field. Boundaries that are mapped, but don't relate to the Public Land Survey System or identifiable ground features can be approximately located**
- **Rural crime site location**
- **Transmitting special agent's location**

NOTE: Navigation with GPS has the following limitations - Department of Defence stated GPS accuracies are to be no worst than ±100 meters when used in the automonous mode.

GPS Application Potential for the Cultural Program

The Bureau's Cultural Program has one of the highest potentials for Global Positioning System (GPS) use because the program is required to report the positions of all sites in UTM coordinates. The Cultural Program is unique in that it is the first program to require absolute coordinates be used for locations of their data.

In the past the only source for these metric coordinates was the USGS 7.5 minute topographic map. Topographic maps can furnish UTM coordinates to approximately ± 40 feet (12.3 meters), which is 0.02 inches on the map. This map accuracy only applies to the well defined features, such as road intersections. It is difficult, if not impossible to read this accurate a coordinate from a paper map. Also, the process of plotting the location of a site on a map in the field allows for additional error. Accurately mapping your location on a topographic map is very difficult. Experienced field map users have to approximate their location due to the lack of well defined detail on maps. Realistic accuracies using 1:24,000 scale maps are ±30 meters and can reach ±100 meters or greater in areas where there is little ground or map detail. GPS use in the cultural program can greatly improve this information.

GPS using differential field methods (2 or more receivers, with one located on a control station) can result in horizontal accuracies of 2 to 5 meters using medium price receivers ($8,000 to $9,900 each). This accuracy is twice the stated accuracy of a USGS 7.5 minute, 1:24,000 scale map or approximately the accuracy expected from 1:10,000 scale mapping products. Obtaining this accuracy with differential GPS (DGPS) is not difficult, but requires training on GPS receivers use, proper field techniques and data adjustments. Most BLM field specialists and technicians can be trained to use this equipment. There will have to be some statewide infrastructure to support GPS applications, but this should have minor organizational impact. If greater accuracy is necessary, survey quality GPS receivers and techniques must be used. Normally these more costly techniques would be used for large scale map control or sensitive locations with ownership/legal needs. (See below) Accuracies to less than a decimeter (10 cm) level can be obtained with survey quality GPS receivers.

The below sections cover various applications to the cultural program for GPS and mapping applications.

1. Cultural Site UTM Positioning and Site Datum Mapping

GPS can be used for site positioning and mapping of individual points, lines(arcs), or polygons(areas). These can be mapped by using a handheld GPS receiver and spending approximately three minutes at the site in the differential mode. New technology allows the user to assign features and attributes to the location using bar codes. If the feature is linear or an area the operator carrying the GPS receiver opens a file and walks the ground trace of the feature needing digitizing. The length or area can be easily calculated.

The resource mapping GPS receivers (Trimble Pathfinder) currently available to BLM field personnel can hold more than five hours of field collected data. Most receivers give latitude and longitude coordinates in the field and the Pathfinder receivers on BLM contract can provide UTM coordinates in the field in the less accurate single unit mode. After data has been collected it is reduced and adjusted by a PC microcomputer using

the differential control data from a GPS base station. This differential process requires two receivers, but improves the coordinate accuracy up to 10 fold, from 50-100 meters (single GPS unit) to better than 5 meters using DGPS post processing techniques. Coordinates and map overlays can be produced on the same day. See Attachment 1.1 for an actual example. Most systems supply coordinates that can be uploaded to the Bureau's and other agency's GIS and CAD systems. UTM coordinates can be derived for local archeological datum then transfered to sites referenced to this datum using ground measurements to the local datum.

2. Site Access Mapping

Access to a site can be mapped using a vehicle mounted GPS. The GPS receiver antenna mounts on top of a vehicle using a magnet. All that is necessary is to start a file as you leave the main road. The coordinates of your route are collected as you drive to or from the site. Attachment 1.1 depicts an access road that was realigned from what was shown on the USGS map. Very accurate distances can be immediately calculated. Data can be plotted on overlays to a 7.5' map using metric UTM coordinates. This is much more accurate than field plotting the route, especially if there are no mapped roads to the site. Accuracies when moving in a vehicle are within 7.5' topographic mapping accuracies if the system is operated within specifications. Cultural sites are visited numerous times during the life of a project. The precise access directions to a site can save many field hours during these revisits, especially if there are no roads or trails in the area. If, roads or trails are unavailable and the site coordinates are known then the GPS receiver can be used to navigate to the site location.

3. Historic Trail Mapping

In the past, trail mapping was done on the ground plotting to maps or using aerial photographs to help identify or interpret the trail location. Combining the use of aerial photo interpretation and GPS mapping while interpreting and verifying the trail location in the field strengthens the interpretation and mapping accuracy. Attachment 1.1 shows the plot of a trail segment that was mapped by walking the trail with GPS used in the differential mode. This could be performed on foot or on horseback. Proper DGPS procedures can map trail locations very accurately in comparison to previous available procedures, because of the difficulty in plotting one's position precisely on a topographic map.

4. Site Base Mapping (Prehistoric and Historic)

Large scale site base mapping can benefit from survey quality GPS measurements. Photogrammetry is the best tool to create large scale base maps of an extensive cultural site. These maps are produced from large scale aerial photography can include terrain, drainage, roads and trails and cultural data that can be photo identified. Photogrammetry requires ground surveyed control points to make the map. GPS can provide a cost effective method to provide this survey control or supplemental control. Because GPS can provide absolute coordinates, like UTM, the resultant maps can have a very accurate UTM grid to within ±1 meter with contours and other map features. GPS can also be used to obtain the locations of ground interpretative features that can't be seen on the photo, and then ploted by their coordinates on the photogrammetric map.

Survey quality GPS was used to map the landnet coordinates and provide supplemental photogrammetric control to an extensive prehistoric site in Whoopup Canyon, near Newcastle, Wyoming. Adjusted GPS coordinates provided very accurate UTM coordinates to the archeological base map. GPS allowed for the landnet, land ownership, and UTM grid to be tied to the large scale topographic map. Conventional ground survey ties to geodetic control would have added $5,000 to the project cost. The supplemental GPS control also allowed for evaluation of the ground control survey's accuracy and assisted in providing an accurate map product for the entire project. Attachment 1.2 shows a portion of a large scale metric base map produced for an archeology site with a 50 meter UTM grid.

If archeology site is spread over a large area, and doesn't have intensive cultural features, then GPS may be more cost effective to field map the site.

5. Availability and Implementation

A. How the program obtains GPS access

1. GPS Receivers

a) Cadastral SC Equipment Cache

Cadastral Survey at the Service Center has a number of both survey and resource mapping GPS systems in an equipment pool. Access to the systems is scheduled on an annual basis by requests through the State's Branch of Cadastral Survey. Because of the large demand preplanning is required. Contact the State Office Geodesist to schedule the use of this equipment.

b) Purchase from the FS/BLM GPS receiver contract

An existing FS/BLM GPS receiver contract can be use to obtain resource mapping GPS receivers. The current contract is for Trimble Pathfinder Professional receivers which can be used in the differential mode and can produce accuracies in the 2 to 5 meter range. These GPS receivers cost approximately $9,900 each and two are necessary for the recommended differential positioning technique, along with a 386 PC computer for post-processing. The use and cost of these receivers can be shared between subactivities. The Rock Springs District Office has purchased two of these units, with field bar code capability. Information on use of this contract may be obtained from the State Office Geodesist.

2. Easy Access Control Base Stations

Most of the geodetic control survey monuments to be used for differential base stations are located at the high points of local terrain. These locations are difficult to access and set up GPS base stations. BLM and other state and federal agencies propose to establish a network of control monuments around the state. BLM is studying the placement of monumentation for use with GPS base stations at our office sites. One monument is in place in the Pinedale

Resource Area's equipment yard. By placing base stations at our offices significant time could be saved with each GPS session.

B. Cost Effective Implementation

The Cultural Program can share GPS receivers with other programs. With proper planning individual sites and more extensive site datums can be positioned with a few days of field work. Many sites require only 3 minutes of on-site time to obtain the 2 to 5 meter accuracy. A District archeologist can accumulate a number of sites during the field season and then visit them with GPS at one time. This could include contractor inventory work and adjacent significant state sites that could effect Bureau management decisions. When the price of DGPS receivers falls and the Bureau has GPS support in place, the cultural program will be a prime candidate for their own GPS receivers.

6. Concerns

A. Geodetic Datum Change

All mapping and coordinate systems are based on a reference datum and mathematical model to best represent the shape of the earth. Currently all maps in our inventory reference the North American Datum 1927 (NAD 27). This means that all previous UTM coordinates derived by the Bureau's Cultural Program reference NAD 27 by default. Because of the improvement in the technologies to measure the shape of the earth the National Geodetic Survey has refined the mathematical model into the new North American Datum 1983 (NAD 83). NAD 83 gives a much better mathematical model of the shape of the earth as it relates to the North American continent. The actual differences in Wyoming can reach 69 meters in longitude and 9 meters in latitude. All new measurement systems, including new and revised maps, will reference this new datum. Computer transformations can be used to process NAD 27 to NAD 83 coordinates or vice versa. GPS in the United States works best with NAD 83 or the military worldwide datum WGS 84. GPS post-processing software can easily transform the coordinates into NAD 27.

Until the Cultural Program national reporting system implements a change, all UTM coordinates should be reported in NAD 27 coordinates. The national level Cultural Program site reporting requires the use of the Universal Transverse Mercator (UTM) system for site location coordinates. The current state and national systems do not include a place for identification of the datum. All past and current coordinates are considered to be in NAD 27 as are all the maps that were used to obtain these coordinates. UTM coordinates in NAD 27 should be used until there is policy to transform these coordinates into NAD 83. Care should be taken when using new or revised topographic maps to insure the proper datum is used when reading UTM coordinates on the maps.

B. Costs

Added costs would, of course, have to be taken into consideration and balanced against increased accuracy in mapping valuable cultural data. A low cost entry into use of GPS technology could be to share GPS receivers with other subactivities or obtain a temporary loan of the systems through the Cadastral SC Equipment Cache. Use of GPS needs to be balanced with the potential time saving due to more effective field mapping of sensitive cultural sites. Increased knowledge and accuracy on the precise site locations for surface compliance and protection can easily offset the cost of GPS equipment.

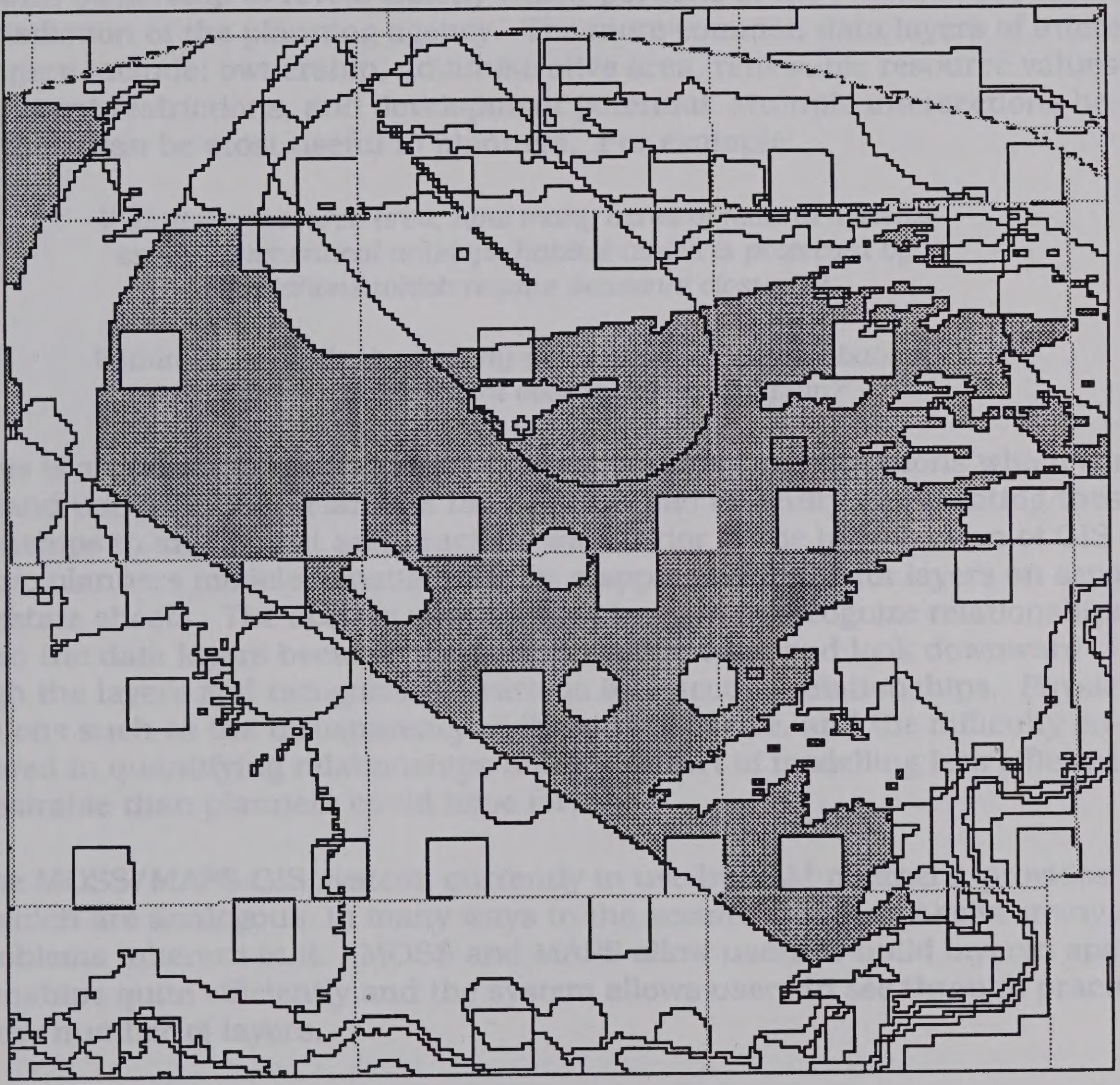
7. Primary Benefit of GPS to the Cultural Program

The primary benefit of GPS to the cultural program is the greatly improved accuracy of positioning of valuable archeological or historical sites. GPS has the potential to improve site location record from the conventional mapping accuracies approaching ± 100 meters to the DGPS capability of 2 to 5 meter accuracies. As BLM and other agencies automate their land management data base there will be an increased demand for more accurate coordinate locations for sensitive resource data. GPS has the potential to support the increased quality in our resource management.

8. Wyoming State Office Contacts

GPS/Geodesy	Mike Londe, WY942	6209
Mapping Science Senior Tech. Specialist	Bruce Keating, WY941	6245
GIS Digitizing	Patrick Madigan, WY941	6238
Aerial Photography	Gretchen Meyer, WY941	6243
Photogrammetry	Karen Shumac, WY941	6246

Data Base Analysis of MOSS/MAPS Spatial Data
In Support of Bureau of Land Management
Resource Management Planning



David A. Plume
Area Geologist & Planning Team GIS Specialist
Bureau of Land Management
Vernal District Office
Diamond Mountain Resource Area
Vernal, Utah

November, 1991

Introduction

In land use planning spatial data takes on its greatest value when related data sets are combined through some form of intersection. For example, a spatial model of a renewable resource becomes significantly more meaningful when combined with ownership to reveal exactly which portions of the resource are under the jurisdiction of the planning agency. The more common data layers of interest to planners include: ownership, administrative area, renewable resource values, management restrictions, and development potential. Multiple intersections between these can be most useful to planners. For example:

> *Within the resource area, how many acres of federal mineral estate cover critical antelope habitat which is protected by stipulations which require seasonal closures?*
>
> *Within these lands, how many acres have a high probability of mineral development over the life of the plan?*

This is a but one example of the variety of multilayered questions which come up in land use planning. Planners have always had difficulty representing these relationships in an efficient and practical way. Prior to the introduction of GIS systems, planners modeled spatial data by mapping related data layers on separate acetate sheets. The acetate allowed the planners to recognize relationships between the data layers because they could overlay each and look downward through the layers and recognize the various intersecting relationships. Physical limitations such as the transparency of the acetate, scale, and the difficulty encountered in quantifying relationships made this sort of modelling less efficient and desirable than planners could hope for.

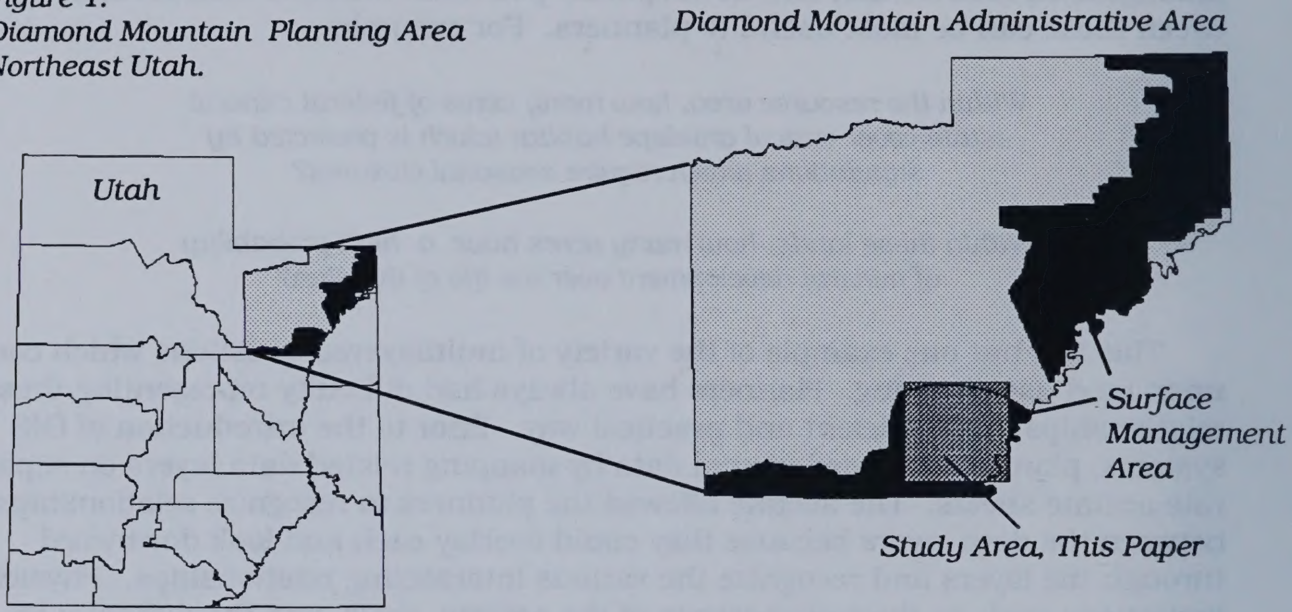
The MOSS/MAPS GIS system, currently in use by BLM planners, provides tools which are analogous in many ways to the acetate model and solve many of the problems inherent in it. MOSS and MAPS allow users to build layered spatial relationships quite efficiently and the system allows users to see through practically any number of layers.

However, the MOSS/MAPS system is not well adapted to the orderly and systematic retrieval of text oriented data which must be used to characterize and quantify the results of intersection. Because of this, the system is not able to reach its full potential to support users. It is possible, however, to move area tables from the MOSS/MAPS system to a data base application and solve this problem. The technique allows planners to take advantage of MOSS/MAPS to relate many spatial layers by intersection and then use a text oriented data base to sort the resulting attribute data out.

The method has additional benefits. Although a planner may carry out the steps necessary to intersect data to answer a single question alone, the new spatial and text oriented data base created has the potential to answer many. As we shall see, the process allows users to build spatial data bases which retain all of the original data contained in their component layers. This creates a data base often suitable for multiple queries which may be performed many times faster and more accurately than methods currently applied using the CROSS command. This approach simplifies verification and makes consistency between queries more attainable. This process was developed during the completion of the BLM, Diamond Mountain Resource Area, resource management plan in 1991.

The Diamond Mountain Resource Management Plan

Figure 1.
Diamond Mountain Planning Area
Northeast Utah.



The Bureau of Land Management (BLM), Diamond Mountain Resource Area, of northeastern Utah, occupies lands on both the Wyoming and Colorado borders, (Fig. 1.). This irregularly shaped federal administrative area includes upland plateau and lowland desert basin county. These lands support a number of renewable resource values amidst a complex pattern of ownership and a variety of administrative areas.

Lands within the resource area host a variety of compatible and conflicting resource values. These lands include important wildlife habitat, threatened vegetative communities, world class archeological and paleontological values. They are also well known for important economic resources. Extensive oil and gas development occurs in the resource area. Other mineral resources include oil shale, tar sands, gilsonite and phosphate. Important utility corridors cross the resource area. Livestock production on federal lands, is an important facet of the local economy.

In 1989, staff members from the resource area office and Vernal district office, began long term planning activities for the resource area. The team spent the next three years documenting the current resource setting, defining planning objectives and formulating five separate planning alternatives. The plan will provide overall management guidance for federal lands on about 711,200 acres of federal surface and mineral estate and another 144,400 acres of federal mineral estate beyond the year 2000.

The planning team completed the plan in draft in the fall of 1991. Planning included simultaneous completion of an Environmental Impact Statement, which measured the benefits and conflicts of each of the alternatives considered in the plan. The overall management goal of each alternative varied from extremes of protection to extremes of development with more balanced alternatives between. The team evaluated the potential impacts and conflicts inherent in each alternative during the summer and fall of 1991.

During this period of planning analysis the team took full advantage of a number of text based data bases created from converted spatial data area tables. The following discussion illustrates the process.

The area chosen to illustrate the process is about 20 miles square, located about 30 miles southwest of Vernal in the Myton Bench area. U.S. Highway 40 passes east to west just north of these lands. The subject lands cover 222,394 acres of largely unpopulated high desert basin in the south central portion of the Diamond Mountain Resource Area. About 85 percent of the area is within the Diamond Mountain administrative area. State lands make up about 10 percent and the remaining 5 percent are privately owned or within the Uintah and Ouray Indian reservation.

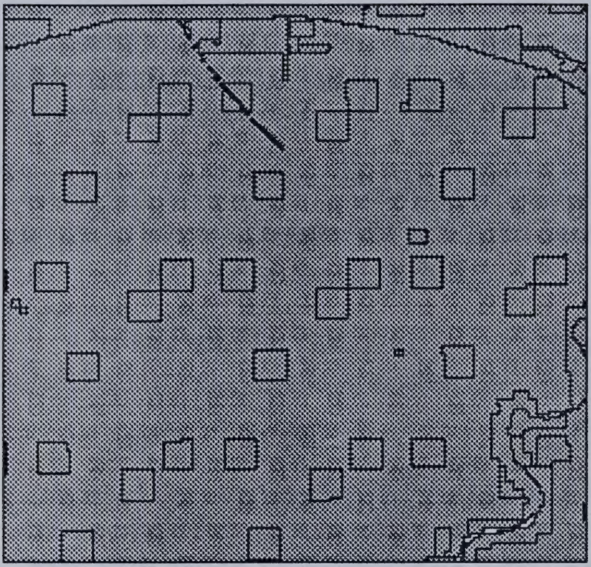
Conflicts occur in planning where the plan imposes restrictions which preclude or inhibit the enhancement of one or more resource values or uses. The intersection of a polygon defining the restrictions with the affected resource polygon defines a region of conflict. There are a variety of useful methods available which could be employed to address the various planning questions which come up during conflict analysis. Acetate overlay is familiar to most land management specialists but is now largely replaced by GIS systems within the BLM. Whether we apply an acetate spatial model to a problem or a digital model to the problem, the basic steps are the same. These are:

1.) Identify the individual spatial components (layers) involved in the planning question,
2.) Perform sequential overlay of each component,
3.) Identify intersections,
4.) Quantify and record the area of intersection.

The Components of the Analysis

Figures 2 through 6 depict the five components of our example planning question (i.e. ownership, management area, resource value, restrictions, and development potential). Each represents a distinct data layer in the Diamond Mountain spatial data base. These are in raster format which allows the use of the MAPS GIS raster system to perform spatial overlay using the commands CROSS and INTERSECT.

Figure 2.
Ownership Data Layer



The shading indicates that nearly the whole data layer has been classified by ownership. Table 1 describes acreage, polygon id, polygon cell value and polygon subject for each of the 15 ownership classifications within the ownership layer. Each unique polygon is represented by a single record in the acreage table. Polygons need not be contiguous.

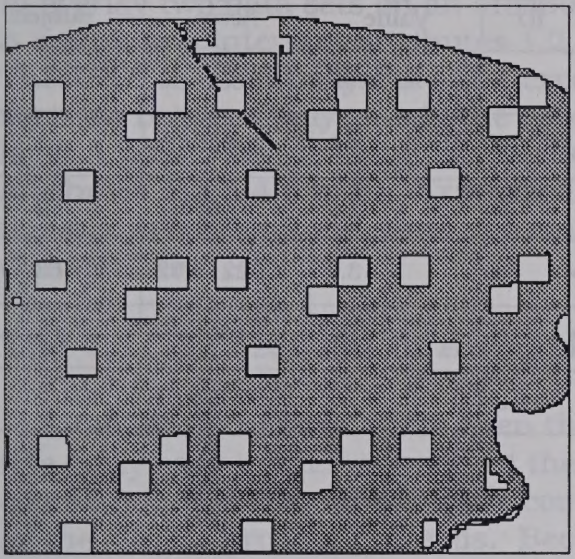
Table 1.
Polygon Attributes for Ownership.

ID	Polygon Value	Polygon Acres	Polygon Subject
1	109.0	6071.38	PXZZZI
2	73.0	5893.46	IIAAI
3	117.0	2062.71	PXZZZZ
4	*142.0	283.55	PYZZQO
5	*52.0	178849.91	FFPDAO
6	*141.0	222.39	PYZZOZ
7	105.0	116.76	PXZZ1O
8	*143.0	22.24	PYZZSO
9	*130.0	177.92	PYZZFO
10	169.0	22278.4	SXZZZZ
11	*54.0	350.27	FFPDAW
12	*51.0	5726.67	FFPDAN
13	99.99	272.43	......
14	*181.0	33.36	SYZZUO
15	*53.0	33.36	FFPDAP
Total		222394.81	

An asterisk in the polygon value column indicates polygons with federal mineral ownership which satisfy the example planning question.

The subject labeling is coded to describe five aspects of ownership: surface ownership, mineral estate ownership , jurisdiction, mineral reservation and withdrawal . Federal ownership is denoted in the first two positions by the letter F. The letter Y indicates partial ownership of the mineral estate. The subject '......' occurs where no ownership data exists.

Figure 3.
Planning Area



These are all the lands in the study area subject to resource area planning.

Table 2.
Polygon Attributes for the Planning Area.

ID	Polygon Value	Polygon Acres	Polygon Subject
1	99.9999	43834.02	....
2	1.0	178560.78	DMRA
Total		222394.81	

Notice again that the symbols '....' have been assigned as a polygon subject. Again, this indicates that none of the management area occurs within this polygon. Normally this region is referred to as "background". Henceforth all similar occurrences of polygon subjects should be interpreted in this way. This is particularly important during data intersection while using the INTERSECT command.

Figure 4.
Critical Antelope Habitat

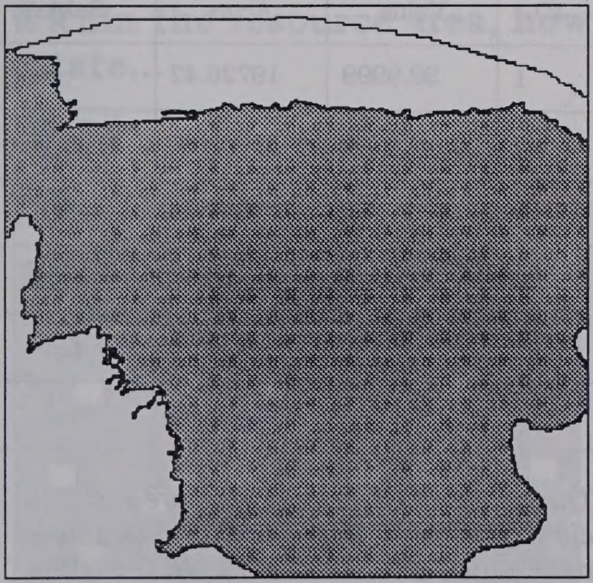
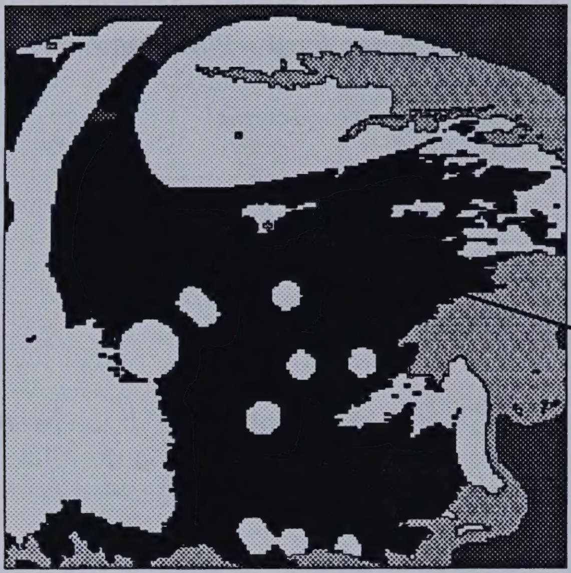


Table 3.
Polygon Attributes for Critical Antelope Habitat.

ID	Polygon Value	Polygon Acres	Polygon Subject
1	99.9999	75630.91	...
2	2.0	146763.91	ANT
Total		222394.81	

Figure 5.
Planning Restrictions.



Under the plan there are four levels of restriction. 1.) Lands closed to leasing, 2.) Lands open to leasing but with no surface occupancy , 3.) Lands open to leasing but with restrictions and 4.) Lands open to leasing with standard restrictions. The level 3 lands are shaded in black.

Table 4.
Polygon Attributes for Management Restrictions.

ID	Polygon Value	Polygon Acres	Polygon Subject
1	99.9999	0	..
2	4.0	20805.04	L4
3	2.0	77465.67	L2
4	3.0	92216.02	L3
5	1.0	31908.10	L1
Total		222394.81	

Figure 6.
Gilsonite Development Potential.

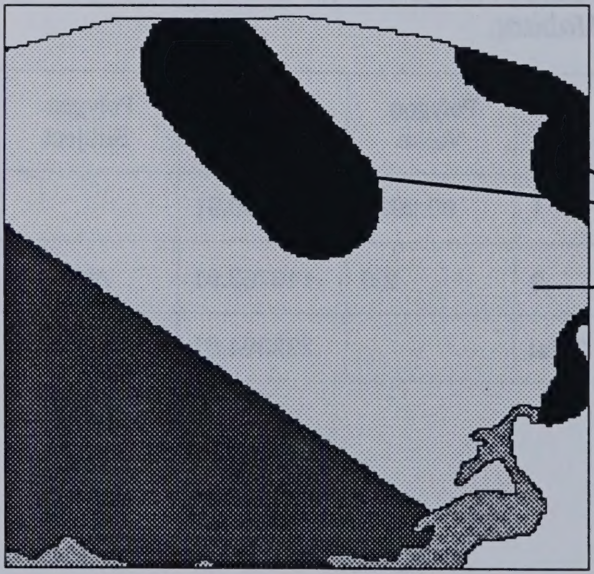


Table 5.
Polygon Attributes for Gilsonite Potential.

ID	Polygon Value	Polygon Acres	Polygon Subject
1	99.9999	19726.42	...
2	2.0	31090.80	High Vein
3	4.0	107989.36	High
4	6.0	55248.43	Mod
5	9.0	8339.80	Low
Total		222394.81	

The black race track shaped area is classified as high potential and is a two mile buffer around the Pariette Gilsonite Vein. Northwest extensions of similar vein buffers are shown along the eastern edge of the map. Lands shaded in white, adjacent to the vein buffers, are also classified as high potential .

Sequential Spatial Overlay

Now that we have identified the components of the planning question we can carry out the spatial overlays, or intersections, which satisfy the planning question. The MAPS raster system includes the CROSS command which may be used to overlay two data sets on an attribute by attribute basis (e.g. intersect map layer A with B and intersect attributes 1,2,3 from A with attributes 4,5,6 from B). INTERSECT is essentially the same except it automatically finds all possible intersections between polygons in the two data layers of interest (e.g. intersect map layer A with B and find the intersection between attributes 1,2,3,4,5 in A with attributes 1,2,3,4,5 in B). Expressed in terms of the examples used here, sequential analysis follows the same pattern for many layers: A+B= C, C+D=E, E+F=G so G=A+B+D+F.

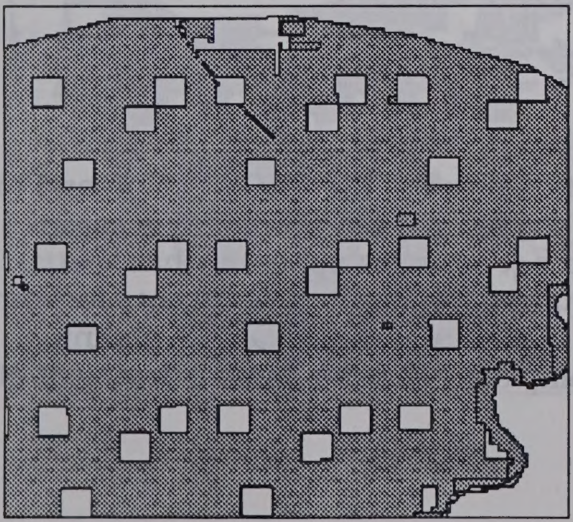
The CROSS Method of Analysis

It is likely that CROSS is often the choice of MAPS users because conceptually it is fairly easy to understand but there are problems inherent in the use of this command. It is the nature of the command to extract subsets of the original data as the overlay process proceeds. Because of this, the final results are often difficult to verify. In addition, with each use of the command polygon subjects are lost and must be re-assigned manually. For complex maps the process of adding new attributes to each new product can be difficult and error prone. The command structure of CROSS can be difficult to use and it too tends to be error prone for similar reasons. While issuing the command the user must manually identify and specify the cell value attributes to combine between the two subject data layers.

Figures 7 through 10 and tables 6 through 9 illustrate the process.

Within the resource area, how many acres of federal mineral estate...

Figure 7.
Cross of Ownership and Management Area.



This data layer represents the intersection of federal minerals and management area by cell value. The parent cell values for ownership are shown in Table 1, marked by asterisk. The spatial intersection of all federal mineral estate polygons in the ownership layer with polygon values of 1.0 in the management map yields the answer to this planning question. The area of the resulting polygon is 178,560 acres.

Table 6 illustrates polygon attributes which are a typical result of the CROSS process. Note that within the table there is no reference to polygon subject since these were lost during the cross process. Note also, the loss of identity in the polygon value field. Although the user can control this, the process to do so can be cumbersome, especially for inexperienced users. The essential form of the command is as follows:

```
 CROSS OWNERSHIP with MANAGEMENT,
ASSIGN 1 TO 142 AND 1,
ASSIGN 1 TO 52 AND 1,
ASSIGN 1 TO 141 AND 1,
ASSIGN 1 TO 143 AND 1,
ASSIGN 1 TO 130 AND 1,
ASSIGN 1 TO 54 AND 1,
ASSIGN 1 TO 51 AND 1,
ASSIGN 1 TO 181 AND 1,
ASSIGN 1 TO 53 AND 1 FOR OMCROSS (New Map Name)
```

(Translation: Assign 1.0 to the intersection of all polygons with the value of 142.0 in the Ownership layer and all polygons with a value of 1.0 in the management layer, etc.)

Table 6.
Polygon Attributes for the Result of the Cross Between Ownership and Management.

ID	Polygon Value	Polygon Area
1	1.00	283.55
2	1.00	174246.34
3	1.00	222.39
4	1.00	22.24
5	1.00	177.92
6	1.00	72.28
7	1.00	3502.72
8	1.00	33.36
9	1.00	0.00
Total		178560.78

Figures 8 through 10 illustrate the continued use of the CROSS command to answer our planning question. In each case the form of the command is essentially the same as shown here. With each step it becomes apparent that spatial data is lost. Each CROSS command can require up to an hour to process for complex maps covering a typical planning area. The total for the example planning question could amount to 2 to 4 hours to complete. This is a large investment of time for a single planning question.

Within the resource area, how many acres of federal mineral estate cover critical antelope habitat...

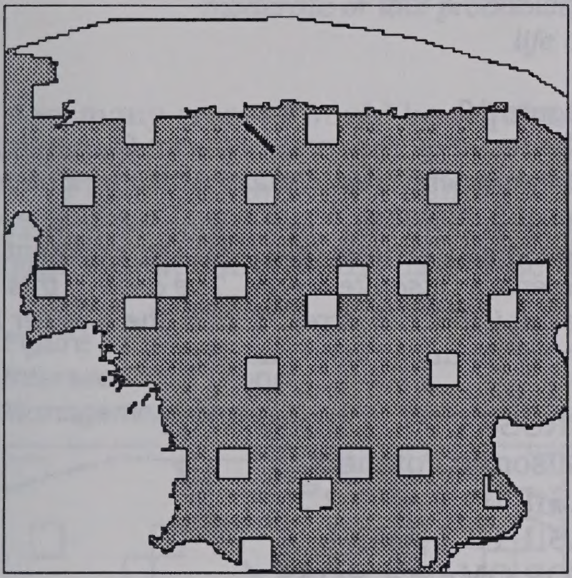


Figure 8.
Result of the cross between Ownership, Management Area and Critical Antelope habitat. The area of the resulting polygon is 130,534 acres.

Cross OMCROSS with Antelope Habitat,
AS 1 TO 1 AND 2
FOR OMACROSS

Within the resource area, how many acres of federal mineral estate cover critical antelope habitat which is protected by seasonal stipulations which require seasonal closures? ...

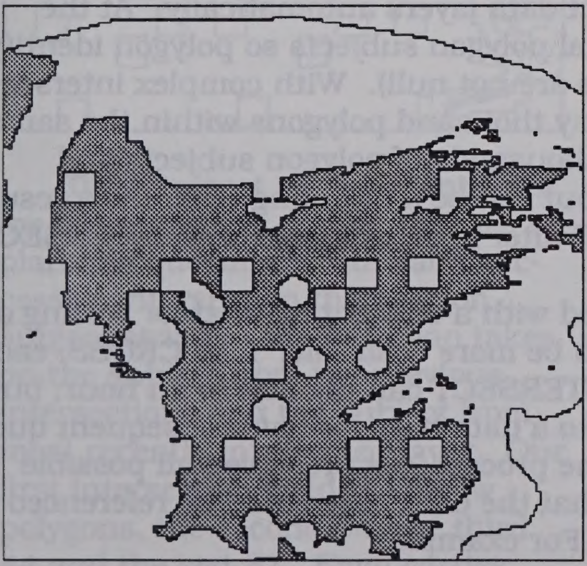


Figure 9.
The result of the cross between Ownership, Management Area, Critical Antelope Habitat and Level 3 Planning Restrictions Requiring Seasonal Closures. The area of this result is 77,176 acres.

CROSS OMACROSS WITH
Planning Restriction ,
AS 1 TO 1 AND 3 ,
FOR OMAPCROSS

Within the resource area, how many acres of federal mineral estate cover critical antelope habitat which is protected by seasonal stipulations which require seasonal closures?

Within these lands, how many acres have a high probability of mineral development over the life of the plan?

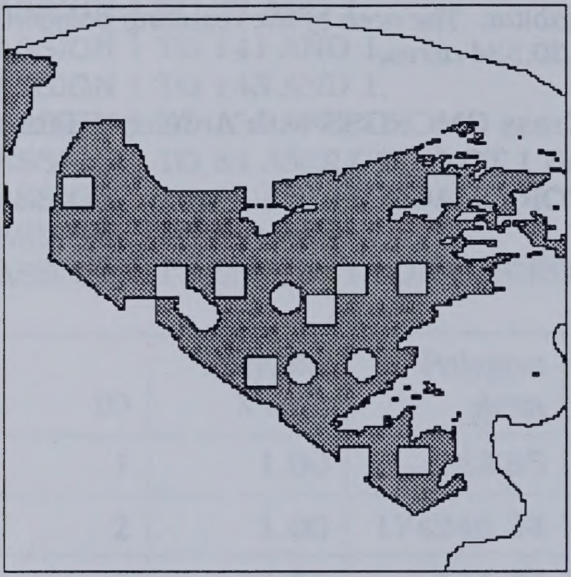


Figure 10.
The result of the cross between Ownership, Management Area, Critical Antelope Habitat, Level 3 Planning Restrictions Requiring Seasonal Closures and High Development Potential Gilsonite lands. The area of this result is 56,226 acres. This is the answer to the original planning question.

```
CROSS OMAPCROSS WITH
Gilsonite Potential ,
AS 1 TO 1 AND 2 ,
AS 1 TO 1 AND 4 ,
FOR OMAPGCROSS
```

The INTERSECT Method of Analysis/Building the Data Base

As a command, INTERSECT is easier to use than CROSS. Mechanically it treats the data in much the same way as CROSS but it finds every possible intersection between polygons in the two subject data layers automatically. At the same time the process preserves the original polygon subjects so polygon identity is not lost (provided the background values are not null). With complex intersections the resulting data layer can have many thousand polygons within the same map. This also means the user has many thousands of polygon subjects and acreage values to deal with. Sorting these out can be a daunting task. As a result, users tend to find their way back to CROSS after a few attempts with INTERSECT.

On the other hand, if users are provided with a efficient method for sorting out the polygon attributes, the INTERSECT can be more desirable. Like CROSS, each of the sequential overlays executed with INTERSECT can take up to an hour; but if the resulting attribute data is converted to a data base format, subsequent queries take literally seconds only. Because the process has preserved all possible attribute combinations, it is only natural that the data base could be referenced for many subsequent planning questions. For example:

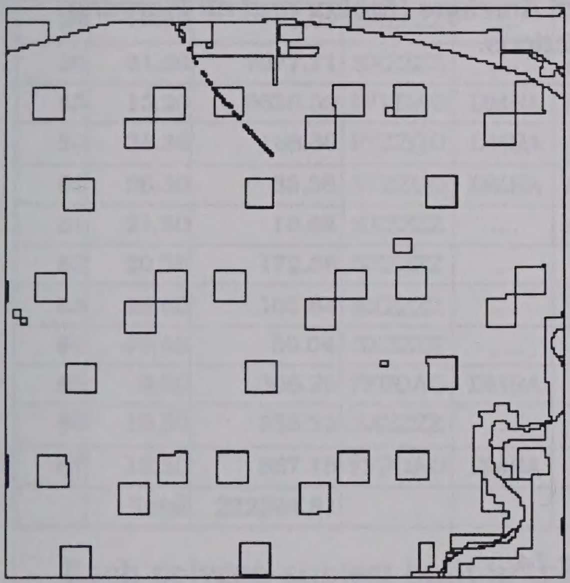
Within the resource area, summarize by both whole and partial federal mineral estate, critical antelope habitat which is protected by stipulations which require seasonal closure and are in each of the four planning levels.

Within these lands, how many acres have either a high, moderate or low probability of mineral development over the life of the plan?

How many crosses would be required to respond to this planning question?

Figures 11 through 14 show the results of sequential overlays using the INTERSECT command. The final intersect yields data suitable for conversion to data base format. Once in the data base this particular question will be easy to answer.

Figure 11.
Intersection of Ownership with Management Area



The intersect process continues for all data layers related by our planning question. With each successive intersection the polygon subject string in the new map takes on the subject from the previous intersections and the subject from most recently intersected layer. Our first intersection yielded 18 new polygons, the second 24, the third 44 and the last 87. Each carries forward identity from previous generations.

Table 7.
The new map includes 18 polygon records, each corresponds to one or more polygons in the map . The polygon subject string now includes values from both parent maps.

ID	Polygon Value	Polygon Area	Polygon Subject	
1	1.10	6071.38	PXZZZ	....
2	2.10	5893.46	IIIAA	....
3	3.10	2062.71	PXZZZ	....
4	4.20	283.55	PYZZQ	DMRA
5	5.20	174246.34	FFPDA	DMRA
6	6.20	222.39	PYZZO	DMRA
7	5.10	4603.57	FFPDA	....
8	7.10	116.76	PXZZ1	....
9	8.20	22.24	PYZZS	DMRA
10	9.20	177.92	PYZZF	DMRA
11	10.10	22278.40	SXZZZ	....
12	11.20	72.28	FFPDA	DMRA
13	12.20	3502.72	FFPDA	DMRA
14	12.10	2223.95	FFPDA	....
15	13.10	272.43	.....	....
16	14.20	33.36	SYZZU	DMRA
17	11.10	277.99	FFPDA	....
18	15.10	33.36	FFPDA	....
Total		222394.81		

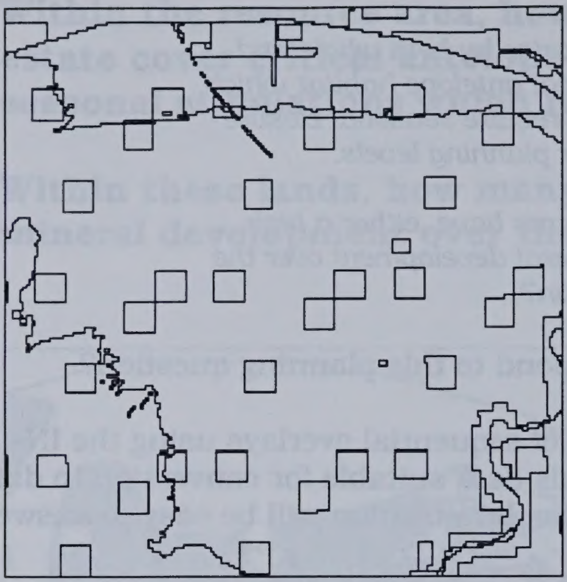


Figure 12.
Intersection of Ownership, Management Area and Critical Antelope Habitat.

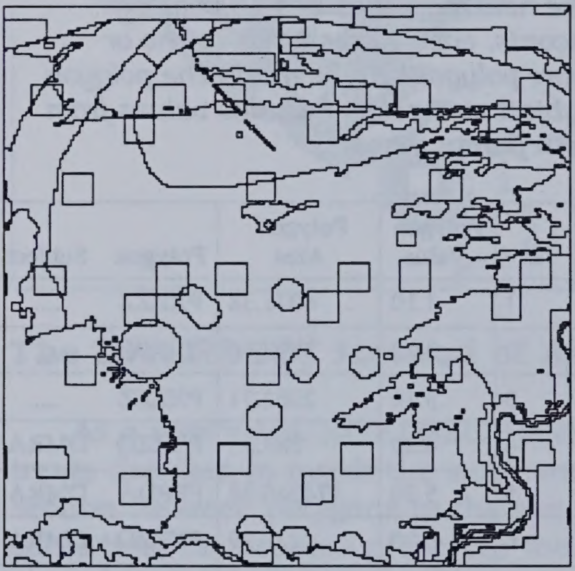


Figure 13.
Intersection of Ownership, Management Area, Critical Antelope Habitat and all Planning Restrictions.

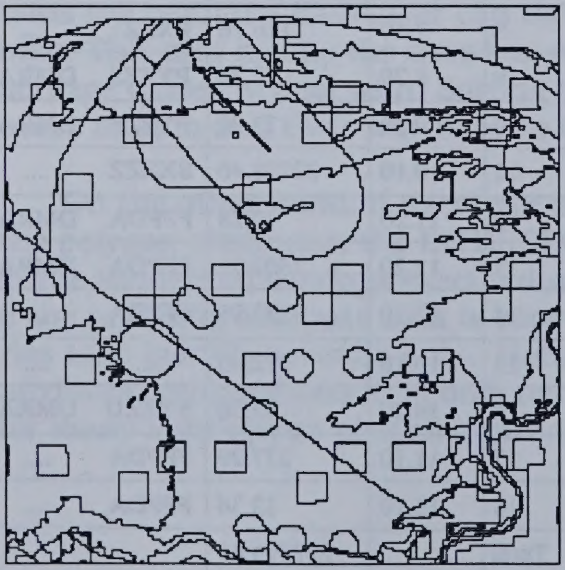


Figure 14.
Intersection of Ownership, Management Area, Critical Antelope Habitat, all Planning Restrictions and Gilsonite Potential.

ID	Polygon Value	Polygon Area	Own	Mgmt	Ant	Lev	Pot
1	1.10	6060.26	PXZZZI	....	...	L4	..
2	2.10	5893.46	IIIAAI	....	...	L4	..
3	3.10	5.56	PXZZZZ	....	...	L4	..
4	3.30	11.12	PXZZZZ	....	...	L4	HI
5	4.30	700.54	PXZZZZ	....	...	L2	HI
6	5.30	116.76	PYZZQO	DMRA	...	L2	HI
7	6.30	461.47	FFPDAO	DMRA	...	L4	HI
8	7.30	8089.61	FFPDAO	DMRA	...	L2	HI
9	7.20	3641.71	FFPDAO	DMRA	...	L2	HI
10	6.20	1256.53	FFPDAO	DMRA	...	L4	HI
20	14.30	177.92	PYZZFO	DMRA	...	L2	HI
21	15.30	50400.23	FFPDAO	DMRA	ANT	L3	HI
22	13.20	3441.56	FFPDAO	DMRA	...	L1	HI
23	16.10	11.12	PXZZZI	....	...	L1	..
24	9.20	328.03	FFPDAO	DMRA	...	L3	HI
29	19.30	745.02	SXZZZZ	....	...	L1	HI
30	21.30	7077.71	SXZZZZ	....	ANT	L3	HI
45	15.20	5626.59	FFPDAO	DMRA	ANT	L3	HI
50	31.30	166.80	PYZZQO	DMRA	ANT	L3	HI
61	36.30	33.36	SYZZUO	DMRA	ANT	L3	HI
81	21.50	16.68	SXZZZZ	....	ANT	L3	LO
82	30.50	172.36	SXZZZZ	....	...	L3	LO
83	19.40	105.64	SXZZZZ	....	...	L1	MO
84	30.40	50.04	SXZZZZ	....	...	L3	MO
85	9.50	305.79	FFPDAO	DMRA	...	L3	LO
86	19.50	355.83	SXZZZZ	....	...	L1	LO
87	13.50	667.18	FFPDAO	DMRA	...	L1	LO
	Total	222394.81					

Table 8, A sampling of the 87 polygon attribute records for the final intersection between each of the components of the planning question. Records 21, 45, 50 and 61 satisfy the planning question. Typical intersections for all of the Diamond Mountain area yielded similar tables containing 2000 to 6000 records. Clearly we needed a tool to help sort these out.

Each polygon subject built in the final intersection contains useful information about either the occurrence or absence of a particular component within the bounds of any polygon. Each subject has been constructed by the sequential concatenation of subjects from intersecting polygons with each sequential overlay. Because of this the resulting subjects are organized in a orderly and regular pattern making them suitable for export to a data base (Table 8).

Even though the subject for each polygon is a single object, as far as MOSS/MAPS is concerned, we can divide our subject string into fields in the new data base. Each division corresponds to each component of the planning question. Therefore the database contains one field for each component, a field for the acreage attribute and a field for the polygon ID.

Once in a data base, the process of sorting out the data is substantially easier.

In this form we can perform a number of operations upon the data. To verify that we have lost no data we can sum each of the component fields alone and compare the result with the original data. For example, in dbase III we may have named the field corresponding the antelope habitat data: 'ANT_HAB'. If we query the data base and sum all acreage values for this field where the field is not empty (i.e. holding a '...' value') then the total will be the same as the area of 'ANT' polygons in the antelope habitat component.

Now we can address the planning question. In dbase III the data base query which is analogous to the planning question is:

```
SUM for (MIN_ESTATE = 'F'.or. MIN_ESTATE = 'Y')
        .and. MGMT_AREA = 'DMRA'
        .and. ANT_HAB = 'ANT'
        .and. PLAN_LEVEL = 'L3'
        .and. GILSONITE_POT = 'HI'
```

The result of the query for the study area is exactly the same as the result of the CROSS method discussed earlier, 56,226 acres. Table 9 shows the output of the same query in report format.

Table 9.
Output in report format listing the data for the polygons which satisfy the planning question.

ID	Polygon Value	Polygon Acres	Surface	Minerals	Mgmt.	Habitat	Level	Potential
21	15.30	50400.23	F	F	DMRA	ANT	L3	HI
45	15.20	5626.59	F	F	DMRA	ANT	L3	HI
50	31.30	166.80	P	Y	DMRA	ANT	L3	HI
61	36.30	33.36	S	Y	DMRA	ANT	L3	HI
Total		56226.98						

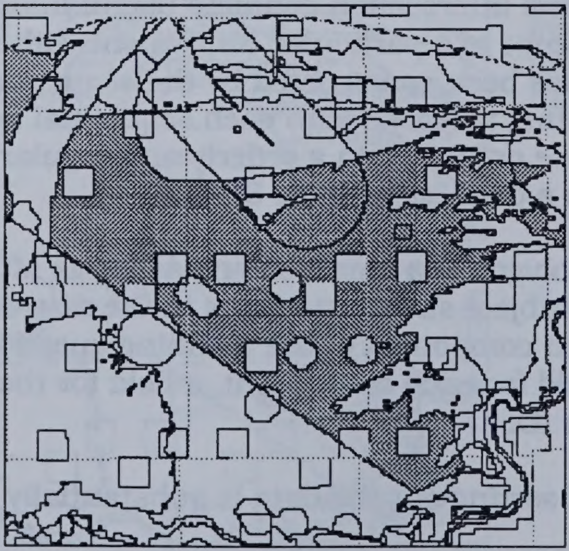


Figure 15.
Intersection of all planning question layers with the spatial solution to the planning question overlain.

For a single question both methods seem to be a lot of work, because they are. However, with data base in hand a planner can quickly address other questions by simple data base queries. Every subsequent query of the database takes far less time than the same query using the CROSS method. In addition, data integrity is maintained since the source data does not change even if the query does. As a rule this is not true for the CROSS method. Additional queries of the data base may be as complex or simple as needed. For example, the problem stated above- data summary by all types of federal ownership, all planning levels and all gilsonite potentials, would be relatively easy to address since most data base management systems, like ORACLE or dbase III, provide the report generating tools the user needs to do this sort of thing. This is simply not possible in MOSS/MAPS for complex intersections.

During the Diamond Mountain planning process we created about fifteen such data bases. These typically contained 2000 to 3000 records each but some as many as 6000 records. Range data bases related ownership, ecological condition, vegetation and grazing allotment (e.g. How many acres of the Kowpi allotment are federal surface composed of browse vegetation type and in poor condition?). Oil and gas data bases were extremely useful for conflict analysis. These related ownership, planning levels, each Level III resource and oil and gas potential (e.g. How many acres of high development potential oil and gas lands, on federal mineral estate are subject to planning level 3 restrictions? What resource values contribute to these restrictions. Of the remainder, how many acres are closed and open?)

The planning team used the different data bases to great advantage. They freed users from having perform complex CROSSes of data for each of the literally hundreds of planning analysis questions which came up. This represented a great savings of their time and it allowed more efficient use of the GIS system. Many would simply have been ignored without the ability to experiment and perform many queries under many different criteria.

The process also insured agreement between users since common data layers, such as ownership, were always the same even if each specific data base related different resource components. No matter which data base was queried, if the user asked for the number of acres of federal surface alone, his answer would agree with any of the other users no matter which data base they queried. In addition, the data is in compact and verifiable form. At any time in the future we can repeat the analysis and get the same results and demonstrate how we achieved those results.

The intersected spatial data bases proved to be useful as well. On screen query of the intersected maps provided users with specific information about many data layers with a single query. This allowed users to identify ownership, planning level and potential conflicts for any specific area of interest all at once. In addition, users could build a link between the two data bases by polygon ID.

For any given query of the text data base, users can output a list of polygon IDs corresponding to records which satisfy a query. Programs (CPLs) were written to query the spatial data by polygon ID to produce a plot of all the spatial data corresponding to the results of the text data base query. Similar programs can perform EXTRACT functions based on polygon value. This process would allow users to build a new map to illustrate a specific relationship but the process has some problems because of the way the polygon value is created. This specific technique needs some work before it can be effectively employed.

Conclusion

The word easy is often used in the context of GIS. Users have come to expect a system that is both easy to use and conceptually easy to understand. Spatial intersection in MOSS/MAPS is neither. However, the conversion of data to more user friendly text oriented data base system does address half the problem at least. Perhaps in the long run this will allow users to address the other.

ADS - PAST, PRESENT AND FUTURE

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ABSTRACT

ADS has come a long way over the past five years. Recent improvements enabled easier and more accurate data capturing and improved the user interface. The advantages of the next ADS release include better edgefitting, an ADS/ORACLE bridge, a faster MERGE, access to multiple projects, new features to support GCDB, implementation of maptype 3 and an ADS projection command. Plans for the future include improvements to the database design, more complete processing of DLGs, accurate resolution of duplicate lines, and the completion of the ORACLE features.

INTRODUCTION

When I first started working with ADS in the winter of 1986, it was to test one of the earliest versions of ADS Rev 7. All development was being done on the Data General 300. The programmers felt that it was about ready for release. Barb Duggan got me started and I labored all day to get the map registered and to digitize six lines, two of them twice by mistake. In order to get rid of them, it seemed that all I had to do was get in Edit, plot them and then delete them... no problem. Early the next day, I logged in and instructed ADS to plot the lines. Seven and half hours later, all six were finally on the screen. It looked nice, too. There was a nice banner with the date, time and a revision number in the dialog area next to the plot. After I selected the first line, the software verified which line it was and I deleted it. Then ADS erased the screen because the dialog area was full. No problem! I remembered where that line was on the screen. I could select it from memory. But there was no fooling ADS. It knew there was nothing displayed. I was going to have to wait another 7 hours to plot it again!

ADS PAST

ADS has come along way since then. That particular version of ADS was severely limited. In fact there were lots of limitations in those days. The Data Generals available for developing applications at the Service Center were slow and the Fortran was an old, cumbersome, non-standard version. A state-of-the-art terminal was a Tektronix 4014. Most ADS applications took hours just to compile and bind and it was necessary to overlay subroutines efficiently in memory to avoid the continual swapping which made the software so slow. In actuality, the people who wrote and supported the GIS software under these circumstances worked miracles.

In the early versions of ADS, no projection was entered at the time the map was registered. Since the software assumed that all maps were UTM and rectangular, only good results could be obtained from 7.5′ quads. All processing was done in map inches. Converting from ADS format to MOSS format was a two step process which was only for the strong at heart. Digitizing and editing was a leisurely process since the response time was so slow. And the only possible way to enter data into ADS was by digitizing. Even if coordinate data was available, it would have to be plotted and then digitized. And data was limited to 499 points on a line and 499 symbols, lines or polygons.

ADS PRESENT

The version of ADS now distributed and in use throughout the BLM is far more capable and responsive. Although we continue to experience problems with the Prime computers, they are still much quicker and more versatile than those old Data Generals. The tools available for use by the developers make the programming and maintenance activities easier and more efficient. Most users have traded their Tektronix 4014s for GraphOns or Pericoms.

The ADS software itself has become capable of handling more complex applications, such as:

Map Registration

The user can register most maps projected in any of the 20 projections supported by the BLM's GIS and obtain good results. However, even though the user has the option to force the map to scale, it is done poorly and the results are still inaccurate. This can result in gaps between maps or maps which overlap once they are converted to map coordinates for MOSS.

Data Entry

Many improvements have occurred in the process of capturing data at the digitizing tablet. Most significant is the ability to view the data as it is being captured. Built into the capture menu are many options which provide the user with the capability to tailor the digitizing environment to suit particular needs.

Digitizing is no longer the only way to enter data into ADS. USGS Optional Format DLGs can be reformatted to ADS format. The user can convert PCCS coordinate files into point and/or line data. The Parcel Generator may be used to combine record data with PCCS data in ADS. The GENERATE command in EDIT permits screen digitizing, import of coordinate data from a MOSS export file or a COGO coordinate file, or coordinates can be generated in 2-D using a limited set of COGO commands. It is even possible to bring some MOSS files directly into ADS using the MOSS command MOSS2ADS.

Editing

Those 6 lines which took 7.5 hours to plot in 1986 will appear on the screen almost instantly in today's ADS and the user may specify the color if desired.

In an effort to obtain better data continuity between adjacent maps in MOSS, the EDGEFITting algorithm was modified to do the matching in projected coordinates rather than map inches. This produces excellent results when the adjacent maps fit together well. However, because of the poor forcing done in CAPTURE, these adjacent maps could actually overlap or have gaps between them which can make the data worse.

ADS to MOSS Conversion

It is now very easy to convert from ADS format to MOSS format. The user is presented with a list of options:

32 bit or 16 bit MOSS files
Batch or Interactive
10 or 16 character MOSS mapnames

Then a prompt line appears which displays a list of information necessary to convert files. If the user has the correct ACL's, the data is converted. There are still some quirks in this process, usually involving islands. Hopefully the last of those have been tracked down and removed.

Enhancements

There are several improvements in the existing code of which many users may not be aware. The SELECT command in EDIT can now be used to select more than one item. The user has the option of identifying the items to be SELECTed with the crosshairs, by specifying a style of items to be selected, or by various windowing options. Once multiple items have been identified, the user can list their item numbers, or PLOT, DELETE, MODIFY or DUPLICATE the SELECTed set.

THE NEXT ADS

The staff at the Service Center has been very active since the last release. The changes to ADS which will have the most impact are those made to eliminate the runtime errors experienced at many sites and to reduce the problems associated with edgefitting.

Runtime Errors

After the last release of ADS, many sites called to report frequent, apparently random crashes when running ADS. The errors were usually pointer faults, access violations or illegal segnos. The variety of the errors made the entire problem overwhelming. And, since the problems weren't occurring on the Prime 6550 at the Service Center, it was difficult to debug. One day while trying to demonstrate some ADS feature at the Colorado State Office, I was thrown out of ADS so frequently that it was embarrassing. However, a reproducible failure was found. Every time that the MAPS command was executed in EDIT after a certain series of EDIT commands, the software failed. Tracking it down by the address gave no indication of the problem. So the entire system was recompiled on the Prime 9955 at the Service Center and both the original version and the version from the 9955 were taken to the Colorado State Office. After verifying that the failure could be induced at will on their machine, the version from the 9955 was loaded. The software still failed. As a final test, the original was reloaded and it no longer failed! Now we were really baffled. Prime certainly lent a sympathetic ear but really didn't offer much help. Most failures seemed to be associated in some vague way with some of the old Fortran V coding practices from the days of the Data Generals. An extensive modification of the code was undertaken to remove these non-ANSI standard practices. So far, it appears successful.

EDGEFIT

The problems with EDGEFITting were tracked down to poor map registrations. Even though the user specified that the map be forced to scale, it was not.

The original technique used for matching lines between maps involved measuring the distance along the side of the map to each line. This was done in map inches and, unless the sides of the maps were equal, the results which looked perfect in ADS were indeed less than perfect in MOSS. Since the projection of the map is now stored in the ADS header, the ability exists to convert to map coordinates to do the matching. As mentioned before, this worked beautifully if the two maps fit together well. Unfortunately, many maps overlap or don't touch at all. This can be caused by a variety of things. In general, the quality of the original base map is usually the problem. These bad fits occur where a tight registration was not obtained.

In order to ensure good fits, an algorithm was installed to force the data to fit the registration points. Excellent results were obtained in digitizing tests. However, there are thousands of digitized maps out there which still have this problem. I made the decision to have the software force the data automatically when encountered in ADS. This seemed like it would be the easiest way to handle it since this would avoid requiring a massive reformatting effort by the users. Unfortunately, the implementation was not exhaustively tested and some anomalies were uncovered during Beta testing. This resulted in the loss of data at some of the first sites which attempted to put this feature into production. Our sincerest apologies to everyone who lost work as a result of this. We are attempting to put into effect measures which will prevent this from occurring in the future.

Up until recently, Roswell District Office in New Mexico was unable to run EDGEFIT at all. After much experimenting, it was discovered that unless ECL was ON prior to executing ADS, EDGEFIT would not run.

ORACLE Interface

As most users are aware, MOSS was released with a MOSS/ORACLE bridge. Late last spring, an experiment was undertaken to determine if an ADS/ORACLE bridge would be practical. Most information found in a typical ADS data file is written to ORACLE tables. Efforts have been made to make this as automatic as possible. The tables are built for the user by selecting an option on a menu. Since polygon information is located in three different tables, the data is automatically joined for the user. The ORACLE menu permits the user to perform these ORACLE tasks from ADS:

1. Create and enter data to an ORACLE table
2. Describe an ORACLE table
3. Enter a SQL command
4. Query the Master database

To demonstrate a practical use of ORACLE in ADS, the SELECT command in EDIT was modified to allow an ORACLE-like WHERE clause to be appended when performing multiple SELECTs. The resulting SET of data can be listed, displayed, modified, deleted or duplicated. It is an easy to use and flexible enhancement. The implementation of this capability is incomplete. Currently, if the base data is modified after the ORACLE table is created, the user must recreate the ORACLE table. They are not automatically maintained. It was decided to release these functions to the field since they do provide a much needed capability. Just be cautious when using them.

Care has been taken to ensure that the software will run at those sites which do not have ORACLE. All the ORACLE commands are isolated and as long as the user does not execute them, there will be no problem.

Many sites are struggling with the issue of database tracking and maintenance. ADS now has an additional enhancement in this area.

When updating the MASTER.DT, there will be an option to maintain these tables in ORACLE. These ORACLE tables contain more information than the flat file. The resulting tables are designed to allow the user to perform the following queries:

1. List the maps covering a specified theme
2. List the themes available for a map
3. List the maps covering a specified area
4. Display the maps covering a specified theme
5. Display the maps covering a specified area

In the future, the user will be able to frame their own queries.

MERGE

ADS.MERGE has been written to keep it from losing the font information. In the process, it was modified to speed up the removal of duplicate lines. Although it is faster, new problems have been uncovered which will not be fixed before the next release. Duplicate line removal requires quite a bit of intelligence written into the code. Recognizing parallel lines may be a problem. Now that forcing to scale works so well, parallel lines will be encountered more frequently.

GCDB Support

There have been several enhancements made to the ADS system to support the GCDB collection effort. Primary among these are the new features added to facilitate the QLINK application. (The name, QLINK, comes from a program developed in the Wyoming State Office.) These enhancements are designed to facilitate generation of PCCS labeled points defining irregular surveys.

Three commands were added to ADS EDIT. They are:

QASSIGN - This program takes unlabeled ADS polygons generated from PCCS data, including irregular surveys. Using a point inside the polygon, it searches the LLD files to find all possible parcels to which this polygon could belong. It is possible to find 0 to 20 possible descriptions, such as lot, tract or aliquot part identifiers, all of which will become ADS attributes for that polygon.

QVERIFY - This command, which is executed similar to VERIFY, displays all polygons. Those polygons which have the requested number of attributes will be highlighted. As it proceeds through the polygons, the user picks the correct attribute from those listed in the menu. It has several nice features which can be used to speed up the process. The intent is to allow the user to prepare the data base for removal of lines between adjacent polygons.

QDUMP - Takes the final polygons, including their attribute and symbol information, and writes it to an ASCII file in the format specified by GCDB. This format is similar to the QFILE format but contains additional information.

For more information, contact the GCDB staff at the SC.

Other enhancements were implemented to make this application work. They have been or will be discussed elsewhere.

Although the code will be included in the next release of ADS, it should be considered BETA code and used cautiously. Experiment with it and verify the results before making a commitment to use it. Most likely, the biggest problems will occur during display while in the QVERIFY process.

Multiple Projects

1 MFD only

Access to maps in multiple projects in the same MFD will be possible by creating a PROJECT.DT file containing a list of up to 20 projects in the order in which they are to be searched. The PROJECT.DT may be in the current directory or PTHBLK.DT may be used to indicate where it resides. Some functions may still write output files in the wrong directory. These will be fixed as soon as practical.

User Interface

Lots of enhancements have been made to the user interface. All the prompts and messages were in data files. Each time one was needed, a file was opened, the message retrieved and the file was closed which slowed the processing. This technique has been replaced with FORTRAN writes and format statements, making the code faster and allowing us the opportunity to standardize messages. Most functions will now query the user about their terminal type, if it matters, and adjust the display appropriately. Programming errors will make an occasional prompt read odd or appear in the wrong place. Please just make note of it, let us know about it and have a hearty laugh.

The order of some of the prompts in CAPTURE will be different in the next version. This was done to eliminate some of the moves between the keyboard and the tablet.

Data already captured will no longer be displayed automatically. Some sites found the wait could be annoying, especially when the display wasn't needed. It can be displayed by using the R key.

ADS Projection

A new addition to ADS's capabilities is the ability to re-project maps. This is executed via the ADS.PROJECTION macro. Only those files associated with a map via the MENUS file will be converted. It has not been thoroughly tested.

Miscellaneous Edit Functions

TEXT handling capabilities have been improved. It is now possible to MODIFY, MOVE, DELETE and RESTORE TEXT features.

The ADJACENT command in EDIT can be used to dissolve lines between polygons based on substrings in their attributes. The addition of an autojoin option eliminates the need for the user to verify each dissolution and graphics are optional. These enhancements were prompted by the GCDB tasks but have proven their worth many times over in other applications.

Attributes can be created using a new option to the ATTRIBUTE command. These attributes are the polygon number and will be located near or at the centroid of the polygon. Options are to create these attributes for all polygons or only those which lack an attribute.

MAPTYPE 3

In support of some functional analysis being done by the SC GCDB staff, the ability to register a MAPTYPE 3 has been implemented. It varies significantly from the old capability. It can be used to register any map which has 4 known corners. Currently, it is limited to protracted data. It was developed and tested on old Master Title Plats that had been drawn to reflect surveys. By using Projection 17, Equirectangular, excellent results were obtained, especially considering how old and unstable the copies were.

ADS FUTURE

Obviously, ADS could be improved immensely. Unless there is a specific need identified and strongly supported, the GIS CMB can only guess at priorities and needs. It is imperative that feedback is provided to the CMB. Some of the plans currently being considered are:

ORACLE Enhancements

As mentioned earlier, the implementation of the ADS/ORACLE bridge is incomplete. Once time permits, ADS will be upgraded so that all functions maintain the ORACLE tables when they exist. Another goal is to enhance MOSS so that the tables built in ADS can also be used in MOSS. This will require modifying the MOSS/ORACLE bridge to provide more flexibility than is currently available.

Another ORACLE related goal is to allow the user to define joins and eliminate the need to remember how the ORACLE tables should be related. Once a join is established, the user will not need to indicate when a join is to be made. It will occur automatically.

Finally, the ORACLE tables are not currently accessed by the production plot capabilities. Lots of flexibility can be added to the plotting facility when these tables can be accessed.

Database Design

In order to be ready for whatever the future holds, it may be necessary to somewhat change the ADS database. To increase the precision of ADS coordinates, they will need to be stored in map coordinates instead of map inches. This will decrease the processing time for several functions (MERGE, ADS2MOS, EDGEFIT) but it will require more disk space to store them. This would also make it easier to display multiple maps together.

Other additions may include more information about CLINEs and/or LINEs which would facilitate MERGE and prepare ADS data for tiling in VPF. This might be a flag to indicate whether or not a CLINE was originally a part of the border or a pointer which would indicate what line on the adjacent map a line matches. Not only would these require modifications to the data files but would necessitate upgrading the software to maintain and utilize the information.

In light of the problems experienced in the last attempt to make database upgrades transparent to users, it is likely that existing data files will not be upgraded automatically. It may be necessary to re-run either CLOSURE and POLYGON or EDGEFIT to add the information to the file. However, existing files will still be supported. Those functions which need the additional information may give less than desirable results when it is absent.

Duplicate Lines

Until the algorithm which is used to identify and remove duplicate line segments is perfected, it will be difficult to further enhance ADS. More analysis of this problem is likely in the future. This will benefit not only ADS but the conversion process from MOSS to VPF and the BUFFER and OVERLAY processes.

Processing DLGS

There have been continuing problems with the DLG2ADS and ADS2DLG programs. When bringing DLGs into ADS, much of the information found in the DLG is either being lost or misinterpreted, requiring extensive editing efforts on the resulting ADS file. This should not be necessary. The program can be improved to do these things for the user. The ADS2DLG program also needs some enhancements. The DLGs produced are not perfect. The attributes/labels are ASCII strings instead of major/minor codes and the way it outputs lines and points is not exactly correct. In addition, it does not combine data types.

Bill Yeager from the Idaho State Office has put together a task order and partially funded a task to improve DLG2ADS. This work will be started immediately following the next ADS release.

SPLICE

There is considerable support for creating a SPLICE function to join line segments together to create longer lines. Features will prevent creating a line that is not an arc, joining lines whose labels don't match or if the line styles are different. When this is completely designed, other restrictions may be applied. However, this will make some of the problems encountered in MOSS BUFFERing easier to resolve.

VPF

As will become clearer from the discussions to come, the polygonal data structure utilized in MOSS is a barrier to the improvement of the BLM's GIS. Prototyping is underway to implement an arc-node data structure to improve the reliability of BUFFER, OVERLAY and MERGE/DISSOLVE in MOSS. ADS utilizes a quasi arc-node structure which is similar to VPF. Conversion of ADS data and software to VPF format is not expected to be difficult. Upon the successful completion of the VPF portion of the GIS improvement project, it will be desirable to convert the ADS data structure to VPF format. Although this task is not presently authorized, it may very well be undertaken in the future.

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